APPENDIX C

QUALITY ASSURANCE PLAN

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FORMER GEORGIA-PACIFIC CALIFORNIA WOOD PRODUCTS MANUFACTURING FACILITY
90 WEST REDWOOD AVENUE
FORT BRAGG, CALIFORNIA
AME PROJECT NO. 16017.01

March 21, 2005

Prepared By

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1.0 INTRODUCTION

This Quality Assurance Plan (QAP) has been prepared on behalf of Georgia-Pacific Corporation by Acton • Mickelson • Environmental, Inc. The purpose of the QAP is to (1) describe the quality assurance/quality control (QA/QC) procedures the project team will follow during concrete, soil and ground water sampling, and (2) provide for collection and reporting of data that are representative of field conditions, and are legally defensible. This QAP reflects the selection of Curtis & Tompkins, Ltd. (C&T), Berkeley, California for routine analyses of soil and ground water samples.

2.0 PROJECT ORGANIZATION

Personnel assigned to the project will be required to familiarize themselves with pertinent protocols and procedures presented in the QAP. Sampling protocols are presented in the Sampling and Analysis Plan (SAP, Appendix A). Experienced staff will oversee and review all procedures related to data collection and analysis. The Project Organizational Chart is included as Figure C-1.

Project organization is summarized below.

2.1 Project Manager

The Project Manager is responsible for the scope, cost, and technical considerations related to the project; staff and project coordination; and implementation of review of overall project quality to the collection, completeness, and presentation of data.

2.2 Project QA Officer

The Project QA Officer is responsible for reviewing the project QA program as it relates to the collection and completeness of data from field and laboratory operations, including the training

of personnel to follow established protocols and procedures. The Project QA Officer also monitors the maintenance and use of equipment necessary to conduct site fieldwork.

2.3 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) is responsible for developing, implementing, and updating the site health and safety plan to be consistent with foreseeable conditions that may be encountered during field operations.

2.4 Project Staff

Project Staff and Field Team Leaders will assist the Project Manager in technical implementation of project tasks, field measurements, and sampling as required. Acton • Mickelson • Environmental, Incorporated (AME) will utilize in-house technical staff for Quality Assurance tasks. Technical staff will report to the Project Manager.

3.0 QUALITY ASSURANCE OBJECTIVES

Data quality objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. Data quality objectives define the total uncertainty in the data that is acceptable for each specific activity during the sampling events. This uncertainty includes both sampling error and analytical instrument error. In order to achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness will be specified. The overall objectives and requirements for this project have been established to allow for a high degree of confidence in the data obtained.

Ground water and soil samples will be collected to qualitatively and quantitatively define an array of select organic constituents. Data quality objectives are summarized in Table C-1.

3.1 Precision, Accuracy, Representativeness, Comparability, and Completeness – Definitions and Equations

Data quality and quantity are measured by comparison of resulting data with established acceptable limits for data precision, accuracy, representativeness, comparability, and completeness (PARCC) as described in U.S. EPA document EPA/540/G-87/003 titled, "Data Quality Objectives for Remedial Response Activities."

3.1.1 Precision

Precision measures the reproducibility of data or measurements under specific conditions. Precision is usually stated in terms of relative percent difference (RPD) or relative standard deviation (RSD). Equations for RPD and RSD are presented below:

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} \times 100$$

Where:

D1 and D2 = the two replicate values

$$RSD = \frac{S}{X}; \text{ and } S = [n (x_i - x)^2/n-1]^{1/2}$$

Where:

S	=	standard deviation
x_i	=	each observed value
i	=	1
x	=	the arithmetic mean of all observed values
n	=	total number of values

The accuracy and precision DQO for lab blank, trip blank, and field blank samples is less than the quantitation limit for each target compound. Accuracy and precision DQOs for matrix spike recovery, matrix spike duplicate, and laboratory control sample recovery are presented with the C&T Quality Assurance Manual (C&T QAM, Appendix C-1).

3.1.2 Accuracy

Accuracy measures the bias in a measurement system which may result from sampling or analytical error. Field and trip blanks, as well as matrix spike QC samples and Laboratory Control Samples (LCSs), will be used to measure accuracy for project samples. Accuracy is calculated using the equation below:

$$\%R = \frac{SSR - SR}{SA} = 100$$

Where:

%R	=	% recovery
SSR	=	spike sample result
SR	=	sample result
SA	=	amount of spike added to sample

The accuracy and precision DQO for lab blank, trip blank, and field blank samples is less than the quantitation limit for each target compound. Accuracy and precision DQOs for matrix spike recovery, matrix spike duplicate, and laboratory control sample recovery are presented with the C&T QAM (Appendix C-1).

3.1.3 Representativeness

Representativeness expresses the degree to which sample data represent the characteristics of the media or matrix from which they are collected. Representativeness will be measured by using the methods (e.g., sampling, handling, and preserving) in accordance with the project-specific standard operating procedures (SOPs) and the documents listed below.

1. "National Environmental Investigation Center (NEIC) Policies and Procedures Manual," May 1986, EPA 330/978-001R.

2. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," November 1986, Third Edition (and Updates), SW-846.

Representativeness will also be measured by the collection of field duplicates or replicates (e.g., volatile organics). Comparison of the analytical results from field duplicates or replicates will provide a direct measure of individual sample representativeness.

3.1.4 Comparability

Comparability expresses the confidence with which one data set can be compared with another data set from a different phase or from a different program. Comparability involves a composite of the above parameters as well as design factors such as sampling and analytical protocols. An acceptable level of comparability will be accomplished through the consistent use of accepted analytical and sampling methods.

3.1.5 Completeness

Completeness is defined as the percentage of data that is judged to be valid to achieve the objectives of the investigation compared to the total amount of data. The equation used for completeness is presented below:

$$C\ (\%) = \frac{D}{P \times n} \times 100$$

Where:

D	=	number of confident quantifications
P	=	number of analytical parameters per sample requested for analysis
n	=	number of samples requested for analysis

3.2 Procedures For Monitoring PARCC Parameters

Precision, accuracy, representativeness, comparability and completeness parameters will be monitored through the submission and analyses of many types of field and laboratory QC samples. These will include appropriate field blanks, trip blanks, laboratory method blanks, field and laboratory duplicates or replicates, matrix spikes, laboratory control samples, calibration and check standards. Laboratory Control Samples (LCS) are samples containing a known or true value which the laboratory prepares and analyses concurrently with project samples. This LCS is most useful in judging analytical accuracy.

The frequency by which the field QC samples will be prepared and submitted is specified in Table C-2. Matrix spike and LCS quality control limits are specified following the C&T QAM (Appendix C-1).

4.0 SAMPLING METHODS

Representative field and laboratory data will be obtained through the use of consistent methods of sample collection, sample preservation, and sample handling. These methods are described in the protocols provided in the SAP (Appendix A).

5.0 SAMPLE COLLECTION AND SAMPLE CUSTODY PROCEDURES

The protocols that field personnel will follow while collecting soil and ground water samples during routine sampling activities are presented in the SAP (Appendix A). A Laboratory Sample Receipt Checklist is presented as Table C-3. Departures from the protocols must be approved by the Project Manager prior to implementation and documented in the field notebook.

6.0 FIELD AND LABORATORY QC REQUIREMENTS

The QC procedures to be followed in the field and laboratory are described below.

6.1 Field Procedures

Quantitative field data will be obtained during ground water quality monitoring (pH, specific conductance, turbidity, dissolved oxygen, and water temperature). Protocols presented in the SAP (Appendix A) describe the instruments used to measure water quality parameters and the calibration methods, standards, and frequency requirements for each instrument. Manufacturer instructions are followed for calibration, standard selection, and frequency requirements for the field instruments. Water levels will be measured with an electronic sounder that requires no calibration.

6.2 Laboratory Procedures

Calibration procedures and frequency of calibration for laboratory instruments are described in the C&T QAM (Appendix C-1). In general, samples will be processed as a batch. Samples will be processed sequentially and samples to be analyzed by a given method will be generally processed on the same apparatus. Samples will be processed without interruption of samples from other projects.

7.0 LABORATORY QUALIFICATIONS

Soil and ground water samples will be analyzed by laboratories certified by the California Department of Health Services pursuant to the provisions of the California Environmental

Laboratory Improvement Act of 1988 (Health and Safety Code, Division 1, Part 2, Chapter 7.5, commencing with Section 100825).

8.0 DATA ASSESSMENT AND MANAGEMENT

The methods for assessing and handling field and laboratory data are discussed below.

8.1 Data Assessment

Data generated during the soil and ground water assessment and monitoring programs will be evaluated for completeness, that is, the amount of data meeting project QA/QC goals. If data generated during the field operations or by analytical procedures appear to deviate significantly from observed trends, the Project Manager and/or Project QA Officer will review field or laboratory procedures with the appropriate personnel to evaluate the cause of such deviations. Where data anomalies cannot be explained, resampling may be necessary. Data quality objectives are summarized in Table C-1.

8.2 Management of Field Data

Field personnel are responsible for monitoring the collection and reporting of field data. Field personnel will also review field measurements at the time of measurement and will re-measure a parameter, as necessary.

Field data will be recorded on field data sheets as they are collected and will be maintained in a project file. Upon delivery to the office, appropriate field data will be entered into the project database to expedite the validation and interpretation process. The Project Manager, Project QA Officer, or appropriate field personnel will review field procedures and compare field data to previous measurements.

8.3 Management of Laboratory Data

Results of laboratory analyses will be reported as specified in the C&T QAM (Appendix C-1). Analytical results will be reported in units of final use. Laboratory calculations will be performed as prescribed for a given analytical method or in conformance with acceptable laboratory standards at the time the calculation is performed. Each laboratory will retain QA/QC records for at least six years. Copies of raw data and supporting data validation information will be available for review at the laboratory and may also be requested as part of QA/QC review. Original laboratory reports will be stored in the project files. The laboratory will provide the data in hard copy and electronic format. Laboratory data will be entered into the project database to expedite data reduction, interpretation, and reporting.

9.0 ANALYTICAL METHODS AND QC REQUIREMENTS

The analytical methods to be followed and the QC requirements are discussed in the following sections.

9.1 Analytical Methods

The laboratory QA program plans for ground water and soil and concrete samples are presented in the C&T QAM (Appendix C-1). Soil and concrete samples will be analyzed by one or more of the following test methods:

- Total petroleum hydrocarbons as gasoline, diesel, and motor oil (EPA Method 8015 Modified)
- Total petroleum hydrocarbons as diesel with silica gel cleanup (EPA Method 8015 Modified) – Extended Chromatogram
- Total oil and grease (EPA Method 1664A)
- Volatile organic compounds (EPA Method 8260)
- Volatile organic compounds (EPA Method 8260 with sample collection by EPA Method 5035)
- Semi-volatile organic compounds (EPA Method 8270)
- Polynuclear aromatic hydrocarbons (EPA Method 8310)
- Polychlorinated biphenyls (EPA Method 8080 or 8082)
- Organochlorine pesticides (EPA Method 8081)
- Dioxins and furans (EPA Method 8280 or 8290)
- Site specific pesticides/herbicides (no EPA Method)
- CAM 17 Metals (EPA 6010/7400)
- Hexavalent chromium (EPA Method 7196)
- Tannin and lignin (to be determined)

In addition to the chemical analyses, selected soil samples may by analyzed for physical parameters by the following ASTM methods or equivalent: dry bulk density and moisture content (ASTM D2937), total porosity (ASTM D854 and D2937), and total organic carbon (ASTM D2974).

Ground water samples may be collected from existing monitoring wells and soil borings as grab ground water samples. Samples will be analyzed by one or more of the test methods listed above.

9.2 Quality Control Requirements

practical quantitation limits are presented in Appendix C-1. Table C-4 presents the requirements for containers, preservation techniques, and holding times for soil and aqueous samples to be analyzed at C&T.

To evaluate the precision and accuracy of analytical data, QC samples will be analyzed periodically for this project. The minimum project requirements for collection and analysis of these samples are listed in Table C-2.

10.0 DATA REVIEW AND VERIFICATION

The Project QA Officer or Project Manager will review laboratory data. Table C-5 outlines the procedures for data verification. If comparison of data to previous measurements or known conditions at the site indicates anomalies, the laboratory will be instructed to review the submitted data while the Project Manager reviews the methods used to collect and handle the samples. If anomalies remain, the laboratory may be asked to re-analyze selected samples; other possible corrective actions are discussed in Section 10.3 below.

10.1 Performance and System Audits

The Project QA Officer or Project Manager will audit field and analytical activities throughout the project. The audit program consists of:

- Observing field activities to confirm that procedures are performed in accordance with project protocols and standard accepted methods, as detailed in the protocols in the SAP (Appendix A).

- Reviewing Daily Field Records, Monitoring Well Sampling Records, and any other data collection sheets during and after field measurements.

- Reviewing laboratory analytical data.

10.2 Preventive Maintenance

Each piece of field equipment will be checked according to its routine maintenance schedule and before field activities begin. Spare parts, including batteries, pH and conductivity meter probes, and other items required for collecting field data will be stored with field equipment to reduce field downtime. The appropriate field personnel will report equipment maintenance and/or replacement needs to the Project Manager or Project QA Officer and record the information on the Daily Field Record. The laboratory is required to perform preventive maintenance as prescribed in its laboratory QA manual.

10.3 Corrective Actions

Corrective actions may be initiated if the data quality objectives are not achieved. The initial step in corrective action will be to instruct the analytical laboratory to examine its procedures to

assess whether analytical or computational errors caused the anomalous results. At the same time, sample collection and handling procedures will be reviewed to assess whether they could have contributed to the anomalous results. Based on this evaluation, the Project Manager, with the Project QA Officer, will assess whether re-analysis or re-sampling is required or whether any protocol should be modified for future sampling events. Laboratory corrective actions are described in the laboratory QA manuals. Any changes in laboratory methods, reporting limits, or QA parameters or limits require written approval by the Project Manager prior to implementation by the laboratory. A copy of the Corrective Action Form is provided in Appendix C-2.

10.4 QA Reporting

Reports that describe soil and ground water sampling activities and results will contain an evaluation of the quality of the data obtained and the laboratory's QA/QC report. These reports will be prepared by the Project QA Officer and reviewed by the Project Manager. Unless otherwise specified, the laboratory will retain raw data and QA documentation for chemical analyses for at least six years after generation. Significant QA issues will be reported and discussed in the corresponding technical report.

11.0 REMARKS

This plan represents our professional opinions, which are based in part on information supplied by the client. These opinions are based on currently available information and have been arrived at in accordance with currently accepted hydrogeologic and engineering practices at this time and location. Other than this no warranty is implied or intended. Any reliance on the information contained herein by third parties is at such party's sole risk.

TABLE C-1

DATA QUALITY OBJECTIVES

DQO Parameter	Aqueous Criteria	Soil/Solid Criteria
Precision	Appendix C-1	Appendix C-1
Accuracy	Appendix C-1	Appendix C-1
Sensitivity	Appendix C-1	Appendix C-1
Representativeness (Field Duplicates)	The relative percent difference (RPD) between the results of aqueous field duplicates should be less than or equal to 30% for results greater than 5 X the QL. The difference between results in aqueous field duplicates should be less than the QL when at least one result is less than or equal to 5X the QL.	to 5X the QL.
Completeness	90%	90%
Comparability	Based on Precision and Accuracy and Media Comparison	Based on Precision and Accuracy and Media Comparison

NOTES:
QL = Quantitation Limit
DQO = Data Quality Objective

TABLE C-2

SUMMARY OF DATA QUALITY INDICATORS FOR FIELD PROCEDURES AND CONDITIONS

QC Element	Frequency	Acceptance Criteria	Corrective Action
Equipment Blank (EB)	One per day per non-dedicated water sampling device used.	< RL for each compound	Investigate the source of contamination and document. Correct sampling/handling protocols. Use professional judgement to determine if resampling is necessary for affected samples.
Trip Blank (TB)	One per VOC cooler storing aqueous samples.	< RL for each compound	Investigate the source of contamination and document. Correct sampling/handling protocols. Use professional judgement to determine if resampling is necessary for affected samples.
Bottle Blank (BB)	One per lot of sample bottles. Analyze if contamination is detected in EB.	< RL for each compound	Investigate the source of contamination and document. Correct sampling/handling protocols. Use professional judgement to determine if resampling is necessary for affected samples.
Field Duplicate	One per 10 samples; minimum of 1 per sample matrix.	Water Sample: ≤ 30% RPD [(a)] Soil Sample: ≤ 50% RPD	Investigate source of variability and document. Correct sampling/analytical protocols unless a matrix effect is indicated. If a matrix effect is not indicated, use professional judgement to determine if resampling is necessary for affected samples.
Review of field notes/boring logs, chain of custody documentation, and laboratory sample receipt documentation	NA	Professional Judgment	Investigate, document, and correct sampling/handling protocols, as appropriate. Use professional judgement to determine if resampling is necessary for affected samples.

Notes:

(a) $$RPD = 100 \times \frac{x_1 - x_2}{(x_1 + x_2)/2}$$

RPD = Relative percent difference
RL = Reporting limit
VOC = Volatile organic compound
NA = Not applicable

TABLE C-3

LABORATORY SAMPLE RECEIPT CHECKLIST

Laboratory: _____ Login No.: _____

Consultant: _____ Project: _____

Date Received: _____ Number of Coolers: _____

1.	If samples were shipped, were they received with the proper shipping documentation (airbill)?	☐ Yes	☐ No
2.	Were custody seals on outside of transport cooler(s)?	☐ Yes	☐ No
3.	Were custody seals on transport cooler(s) intact upon arrival?	☐ Yes	☐ No
4.	Were custody papers dry and intact upon arrival?	☐ Yes	☐ No
5.	Were custody papers filled out properly?	☐ Yes	☐ No
6.	Was sufficient ice used (if appl.)? Temperature: _____	☐ Yes	☐ No
7.	Were all containers intact upon arrival? If no, list below	☐ Yes	☐ No
8.	Were labels in good condition and complete (ID, date, signature, etc)?	☐ Yes	☐ No
9.	Did labels agree with custody papers?	☐ Yes	☐ No
10.	Were appropriate containers used for tests indicated? If no, list below.	☐ Yes	☐ No
11.	Were samples correctly preserved? If no, list below.	☐ Yes	☐ No
12.	Was sufficient sample received for tests indicated? If no, list below.	☐ Yes	☐ No
13.	Were bubbles/headspace absent in VOA samples? If no, list below. Note: Soil sample headspace must be assessed at time of analysis.	☐ Yes	☐ No

Comments: _____

_____

_____

_____

_____

_____

_____

_____

Signature: _____ Date: _____

Title: _____

TABLE C-4

ORGANIC CHEMISTRY PARAMETERS

Parameter	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[7]
TPH/Diesel [3]	Water	EPA 3520	EPA 8015B	14/40 [6]	500 mL	1L G	None
	Soil	CA LUFT[4]	EPA 8015B	14/40 [6]	50 g		
TPH/Gasoline [2]	Water	EPA 5030	EPA 8015B	14 days	40 mL	2 x 40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8015B	14 days	5 g		
Aromatic VOCs (8020 list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
BTXE [1]	Water	EPA 5030	EPA 8021B	14 days	40 mL	2 x 40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8021B	14 days	5 g		
Creosote, coal tar	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
1,4-Dioxane	Water	EPA 3520	EPA 8270-SIM	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270-SIM	14/40 [6]	30 g		
Dioxins & Furans	Water	METHOD[4]	EPA 8280	30/45 [6]	1 L	1L G	None[8]
	Soil	METHOD[4]	EPA 8280	30/45 [6]	10 g		
Dioxins & Furans (Low Concentration)	Water	METHOD[4]	EPA 8290	30/45 [6]	1 L	1L G	None[8]
	Soil	METHOD[4]	EPA 8290	30/45 [6]	10 g		
Gasoline Oxygenates	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
Halogenated VOCs (8010 list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
MTBE (Methyl tert-Butyl Ether)	Water	EPA 5030	EPA 8021B	14 days	40 mL	2x40mL VOA	HCL[8]
			EPA 8260B	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8021B	14 days	5 g		
			EPA 8260B	14 days	5 g		
Nitroaromatics & Nitramines (Explosives)	Water	METHOD[4]	EPA 8330	7/40 [6]	1 L	1L G	None[8]
	Soil	METHOD[4]	EPA 8330	14/40 [6]	10 g		
Organochlorine Herbicides	Water	METHOD[4]	EPA 8151	7/40 [6]	1 L	1L G	None
	Soil	METHOD[4]	EPA 8151	14/40 [6]	30 g		
Organochlorine Pesticides	Water	EPA 3520	EPA 8081A	7/40 [6]	1 L	1L G	None
	Soil	EPA 3550	EPA 8081A	14/40 [6]	30 g		

Note: Presented as Appendix 1 in Curtis & Tompkins Quality Assurance Manual in Appendix C-1
D:/AME/App C QAP/T C-4.xls

ORGANIC CHEMISTRY PARAMETERS

Parameter	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[7]
Pentachlorophenol	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
Phenols (including cresols)	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
Phthalates	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
Polychlorinated Biphenyls (PCBs)	Water	EPA 3520	EPA 8082	7/40 [6]	1 L	1L G	None
	Soil	EPA 3550	EPA 8082	14/40 [6]	30 g		
Polynuclear Aromatic Hydrocarbons	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
			EPA 8310	7/40 [6]	1 L	1L G	None[8]
			EPA 8270-SIM	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
			EPA 8310	14/40 [6]	30 g		
			EPA 8270-SIM	14/40 [6]	30 g		
Semivolatile Organics	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
Volatile Organics (8240 list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
Volatile Organics (extended list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		

NOTES:

1.) Benzene, toluene, ethylbenzene, and xylenes: MTBE (methyl tert-butyl ether) may be added upon request.

2.) Total Petroleum Hydrocarbons as Gasoline: JP-4, mineral spirits, or stoddard solvent may be added upon request. Reporting limits may be higher for fuels other than gasoline.

3.) Total Petroleum Hydrocarbons as Diesel: motor oil, commercial jet fuel, JP-5, hydraulic oil, transformer oil, or Bunker C may be added upon request. Reporting limits may be higher for fuels other than diesel.

4.) CA LUFT: California Department of Health Services Leaking Underground Fuel Tank Manual, October 1989. "Method" indicates that the prep method is an integral part of the analytical method.

LEGEND:

VOA: amber VOA vial

G: amber glass

P: Polyethylene

ORGANIC CHEMISTRY PARAMETERS

5.) Holding times specified in 40CFR 136.3 Table 2 (Clean Water Act/ NPDES) and SW-846 Table 2-36 Revision 3, December 1996.

6.) X/Y: X days from sample collection to extraction, then Y days from extraction to analysis.

7.) Samples should be kept at 4^0C from time of collection until analysis. Preserved containers can be supplied by C&T. HCL: hydrochloric acid to pH < 2, H_2SO_4: sulfuric acid to pH < 2, NaOH: sodium hydroxide to pH > 12

8.) Free chlorine should be neutralized with 0.008% $Na_2S_2O_3$.

9.) Prep method EPA 5035, using Encore sampling devices, may be used in place of EPA 5030; contact lab for details.

METALS PARAMETERS

Parameter	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[7]
Cations	Water	EPA 3010A	EPA 200.7 or 6010B	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6010B	6 mo	2 g		
ICP Metals	Water	EPA 3010A	EPA 200.7 or 6010B	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6010B	6 mo	2 g		
ICP-MS Metals	Water	EPA 200.8	EPA 6020	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6020	6 mo	2 g		
Hexavalent Chromium	Water	METHOD[1]	EPA 7196A	24 hr	100 mL	500 mL P	None
		METHOD[1]	EPA 7199	24 hr	50 mL	250 mL P	None
	Soil	METHOD[1]	EPA 7196A	30 days	40 g		
Lead	Water	EPA 3010A	EPA 200.7 or 6010B	6 mo	100 mL	250mL P	HNO_3
		EPA 200.8	EPA 6020	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6010B	6 mo	2 g		
		EPA 3050B	EPA 6020	6 mo	2 g		
Mercury	Water	METHOD[1]	EPA 7470A	28 days	100 mL	250mL P	HNO_3
	Soil	METHOD[1]	EPA 7471A	28 days	0.5 g		
Organic Lead	Water	CA LUFT[1]	CA LUFT[1]	14 days	100 mL	500mL P	None
	Soil	CA LUFT[1]	CA LUFT[1]	14 days	50 g		
Priority Pollutant Metals	Water	EPA 3010A/ Method[1]	EPA 6010B/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
		EPA 200.8/ Method[1]	EPA 6020/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
	Soil	EPA 3050B/ Method[1]	EPA 6010B/7400	6 mo/28d[4]	5 g		
		EPA 3050B/ Method[1]	EPA 6020/7400	6 mo/28d[4]	5 g		
RCRA (8) Metals	Water	EPA 3010A/ Method[1]	EPA 6010/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
	Soil	EPA 3050B/ Method[1]		6 mo/28d[4]	5 g		
Silver in Photochemicals	Water	METHOD[1]	EPA 7420	6 mo	100 mL	250mL P	None
CA Title 26 Metals (CAM 17)	Water	EPA 3010A/ Method[1]	EPA 6010B/ 7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
		EPA 200.8/ Method[1]	EPA 6020/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
	Soil	EPA 3050B/ Method[1]	EPA 6010B/ 7400	6 mo/28d[4]	5 g		
		EPA 3050B/ Method[1]	EPA 6020/7400	6 mo/28d[4]	5 g		
Tributyl Tin ("Organo-tin")	Water	EPA 3520C	GC/FPD	NS	1 L		
	Soil	EPA 3550B	GC/FPD	NS	10 g	1L P or G	None

METALS PARAMETERS

Parameter	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[7]

NOTES:

1.) "Method" indicates that the prep method is an integral part of the analytical method.
CA LUFT: California Department of Health Services Leaking Underground Fuel Tank Manual, October 1989

2.) Holding times specified in 40CFR 136.3 Table 2 (Clean Water Act/ NPDES) and SW-846 Table 2-36 Revision 3, December 1996.

3.) Samples should be kept at 4°C from time of collection until analysis. Preserved containers can be supplied by C&T.
HCL: hydrochloric acid to pH < 2, H_2SO_4: sulfuric acid to pH < 2, NaOH: sodium hydroxide to pH > 12,
HNO_3: nitric acid to pH < 2

4.) 28 day holding time for mercury; 6 month holding time for all other elements.

LEGEND:
G: amber glass

P: Polyethylene

TABLE C-5

SUMMARY OF DATA VERIFICATIONS PARAMETERS AND CRITERIA

Data Verification Parameter	Means of Assessment	Acceptance Criteria	Verification Action
Preservation and Holding Times	Check chain of custody records, field records, and lab records.	See Tables C-3 and C-4	1. If improperly preserved, qualify as estimated (indicated by a "J" following the value in the data summary table) all positive detects (+) and reject (R) all nondetect (-) results. If aromatic compounds have not been properly chemically preserved, data is acceptable if analyzed within 7 days. 2. If holding times exceeded, but sample properly preserved, J all (+) and UJ all (-) results if analyzed in 28 days; if > 28 days, R all (-) results.
Lab Blanks: 1. Method Blank (MB) 2. Instrument Blank (IB)	Check that blanks (sand used as method blanks for soil) were analyzed at the appropriate frequency (MB at one per batch of 20 or fewer samples; IB frequency is method specific); compare results to acceptance criteria.	< Reporting Limit (RL) for each compound	1. If result > 5x blank, no action. 2. If result ≤ 5x blank, but ≥ RL, report as undetected (U) at result level. 3. Use 10x for common laboratory contaminants (e.g., acetone, methylene chloride). 4. If gross contamination > 10x RL exists, use professional judgement to determine if affected compounds in samples associated with that blank should be qualified R.
Surrogate Spikes	Check that all samples and blanks were properly spiked; compare results to acceptance criteria.	See Appendix C-1	1. If any percent recovery > acceptance criteria, J (+) results and accept (-) results. 2. If any percent recovery < acceptance criteria but ≥ 10%, J (+) results and UJ (-) results. 3. If any percent recovery < 10%, J (+) results and R (-) results.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Check that MS/MSDs were analyzed at a frequency of one per batch of 20 or fewer samples; compare results to acceptance criteria.	See Table C-2 and Appendix C-1	1. If any percent recovery > acceptance criteria, J (+) results and accept (-) results associated with the MS/MSD. 2. If any percent recovery < acceptance criteria but ≥ 10%, J (+) results and UJ (-) results associated with the MS/MSD. 3. If any percent recovery < 10%, J (+) results and R (-) results associated with the MS/MSD. 4. If RPD outside limits, J (+) results and UJ (-) results associated with the MS/MSD.

TABLE C-5

SUMMARY OF DATA VERIFICATIONS PARAMETERS AND CRITERIA

Data Verification Parameter	Means of Assessment	Acceptance Criteria	Verification Action
Laboratory Control Sample (LCS)	Check that LCSs were analyzed at a frequency of one per batch of 20 or fewer samples; compare results to acceptance criteria.	See Tables C-2 and C-3	1. If any percent recovery > acceptance criteria, J (+) results and accept (-) results associated with the LCS. 2. If any percent recovery < acceptance criteria but ≥ 10%, J (+) results and UJ (-) results associated with the LCS. 3. If any percent recovery < 10%, J (+) results and R (-) results associated with the LCS.
Field Blanks: (Water) 1. Equipment Blank (EB) 2. Trip Blank (TB) 3. Bottle Blank (BB)	Check that aqueous sample blanks were analyzed at the appropriate frequency (Table C-2); compare results to acceptance criteria. .	< RL for each compound	Water Sample: 1. If result > 5x blank, no action. 2. If result ≤ 5x blank, but ≥ RL, report associated samples as undetected (U) at result level. 3. If gross contamination > 10x RL exists, use professional judgement to determine if affected compounds in samples associated with that blank should be qualified R.

TABLE C-5

SUMMARY OF DATA VERIFICATIONS PARAMETERS AND CRITERIA

Data Verification Parameter	Means of Assessment	Acceptance Criteria	Verification Action
Field Duplicates	Check that field duplicates were analyzed at the appropriate frequency (Table C-2); compare results to acceptance criteria.	Water Sample: ≤30% RPD [(a)] Soil Sample: ≤50% RPD Vapor Sample: ≤50% RPD	Detection in Both Samples: 1. If results ≥ 5X quantitation limit (QL) in both, and RPD > acceptance criteria, J the result in both samples. 2. If result < 5X QL in one or both samples, and RPD > acceptance criteria, use professional judgment to accept (A) or qualify (J or UJ) results, taking into consideration the increased variability of data near QL. 3. If precision data for the field duplicate pair, surrogate compound recoveries, and laboratory MS/MSD indicate an extremely heterogeneous matrix at the site or potential sampling error, professional judgment should be utilized to apply field duplicate actions to all samples of the same matrix. Detection in Only One Sample: 1. Do not evaluate based on RPDs. 2. If result of (+) result ≥ 2X QL for water and ≥ 3X QL for soil and soil vapor, qualify (J or UJ) results in both samples. 3. If result of (+) result < 2X QL for water and < 3X QL for soil and soil vapor, use professional judgment to accept (A) or qualify (J or UJ) results, taking into consideration the increased variability of data near QL. 4. If precision data for the field duplicate pair, surrogate compound recoveries, and laboratory MS/MSD indicate an extremely heterogeneous matrix at the site or potential sampling error, professional judgment should be utilized to apply field duplicate actions to all samples of the same matrix.
Review of field notes/boring logs, chain of custody documentation, and laboratory sample receipt documentation	NA	Professional Judgment	1. Accept (A), qualify (J), or reject (R) results, as appropriate. 2. Examples of situations where qualification or rejection of results should be considered include, but are not limited to: volatile analysis of coarse-grained materials, compromised sample containers, sample headspace, etc.

TABLE C-5

SUMMARY OF DATA VERIFICATIONS PARAMETERS AND CRITERIA

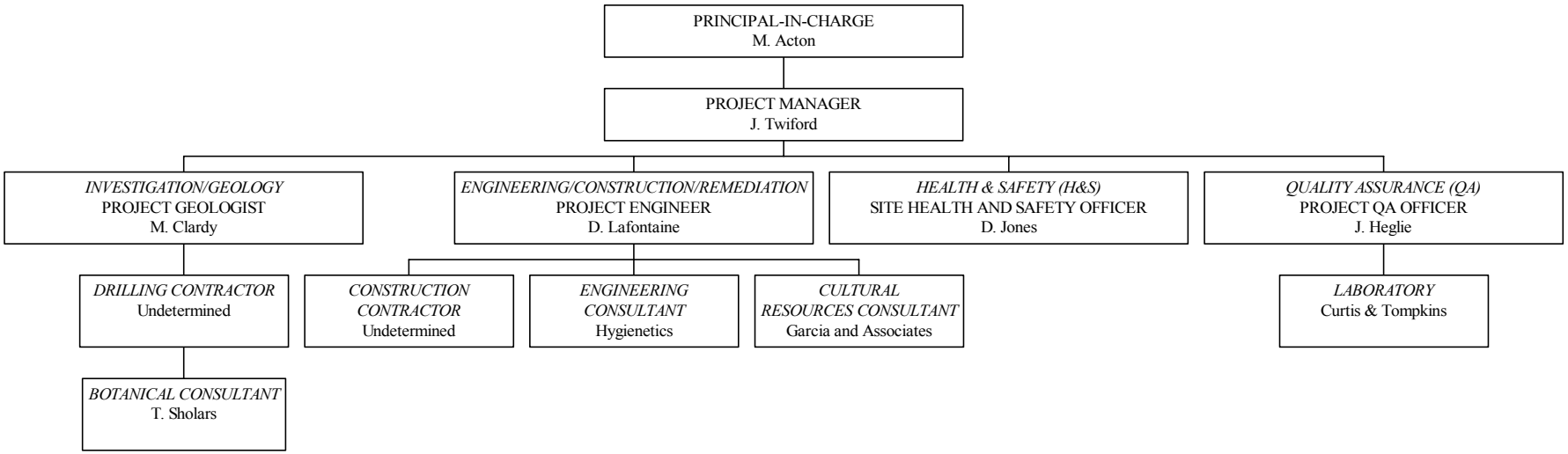
Data Verification Parameter	Means of Assessment	Acceptance Criteria	Verification Action

Notes:

(a) $$RPD = 100 \times \frac{x_1 - x_2}{(x_1 + x_2)/2}$$

RPD = Relative percent difference
NA = Not applicable

FIGURE C-1
PROJECT ORGANIZATIONAL CHART



APPENDIX C-1

CURTIS & TOMPKINS, LTD
QUALITY ASSURANCE MANUAL

APPENDIX C-1

CURTIS & TOMPKINS, LTD
QUALITY ASSURANCE MANUAL

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Quality Assurance Manual

Version 7.4
Effective: 06-December-2004

This manual details the policies, practices, and procedures for ensuring that the quality of laboratory measurement data generated by Curtis & Tompkins Ltd., located at 2323 Fifth Street in Berkeley CA, meets the requirements of the National Environmental Laboratory Accreditation Program (NELAP).

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Dr. Bruce Godfrey, President & Lab Director — Date 12/07/04

Teresa Morrison, QA Director — Date 12/01/04

John Goyette, Operations Manager — Date 12/1/04

Copy Number: 1 of 1 Printed Copies

C&T QA Manual
Table of Contents

1.0 INTRODUCTION QA POLICY

This document is Curtis & Tompkins' Quality Assurance Manual, which describes the laboratory procedures, practices, and philosophies that ensure data quality and reliability. The equally important aspect of client service quality is implicit in the text, but not explicitly stated here in terms of practices and procedures. We can only exist at the pleasure of our clientele. Satisfying their requirements for timeliness and professionalism, in every aspect of their interaction with our organization, is an essential part of our existence.

We at C&T are committed to a process of continuous quality improvement through employee participation. As a client-driven organization, we strive to provide a high quality product at a reasonable price. C&T's policy is to generate chemical measurement data of known quality as defined by adherence to specifications for accuracy and precision. The laboratory produces data that is both technically and legally defensible, for the intended use of our clientele. This manual outlines, for both clients and C&T employees, the measures taken to ensure and document data quality, monitor and assess quality activities, and the mechanisms that promote quality improvement.

The foundation of C&T's quality program is our employees, and their participation in developing and improving data quality and productivity while meeting client needs. C&T's organization is based on the concept of management participation in laboratory work and employee participation in management. Our employees are encouraged to participate on work teams formed throughout the laboratory in order to develop new products, resolve production or quality issues, and design and implement corrective actions, as required.

The following text outlines the core principles of our organization from which we have built a thriving business of more than 120 years duration.

1.1 Mission Statement

We are professionals in the chemical measurements business, for profit and the satisfaction of our clients and staff. We strive to exceed our clients' expectations while reporting results without bias. People are our greatest asset. We are committed to developing their capabilities in a challenging environment of personal and professional growth.

1.2 Basic Policies

We at Curtis & Tompkins conduct our activities in accordance with the Mission Statement above and:

1. We conform to all laws and statutes of the communities in which we do business, and act with integrity and social responsibility in dealing with our employees, clients, suppliers, and the public.

2. We provide employees with satisfying work, with performance judged objectively and reviewed at least once a year. We pay salaries equivalent to comparable market rates and promote from within wherever possible.

3. We expect a high ethical standard from our employees. We do not tolerate discrimination, sexism, or racism in any form or appearance.

4. We maintain a stringent safety program for the protection of our employees and the public.

5. We have established a professional management system with appropriate delegation, accountability, communication, and control.

6. We maintain written corporate policies and procedures for adherence by all employees.

1.3 Rules of the Game

High quality work begins with, and relies upon, good communication. Accordingly, C&T has developed and implemented the following rules for staff interaction to aid the quality improvement process. These rules are central to the success of the quality program.

1. Be willing to support our mission, vision, values, and policies.

2. Speak with good purpose. Listen actively and often.

3. Be open and honest in your communication with others.

4. Complete your Agreements. Be responsible to yourself and your coworkers.

   (a) Only make agreements you are willing and able to keep.
   (b) Clear up any broken or potentially broken agreements at the earliest appropriate time with the appropriate person.
   (c) Don't commit others unless you have their agreement.

5. If a problem arises, look first at the system, then at the people, then take corrective action.

6. If you can't help the customer, help someone who can.

7. Have the willingness to win, and allow others to win. Commit to win/win relationships.

8. Focus on what works. Discard that which does not work.

9. Bad news does not get better with time. Don't shoot the messenger.

10. "Raise the flag" to seek help when you are overloaded, and offer help to others whenever you are able to.

11. Maintain a sense of humor.

12. Innovation is good. Risk it.

13. Be "proactive". Generally, it's better to ask forgiveness, than to seek permission.

1.4 Policy on Ethics and Data Quality

Without a solid ethical foundation, C&T will fail. C&T expects its employees to be honest, and to know the difference between what is right and wrong. C&T expects its employees at all levels to adhere to a consistently high ethical standard. At C&T we don't lie, cheat, steal or deceive each other, our customers, suppliers or anyone else. Frequent honest and open communication is expected at all levels of the organization. C&T strives to actively recruit, select, and promote employees who espouse these values, and terminate the employment relationships with those who do not.

The purpose of this section is to describe C&T's policy regarding ethics and data quality, and to document the steps which must be taken when the quality of data is suspected or known to have been compromised by a deliberate act, error or omission. It addresses the code of ethical conduct expected of all C&T employees, and applies at every level in the organization.

C&T expects its employees to conform to all laws and statutes in the locations where we do business, and to act with integrity and social responsibility in dealing with fellow employees, clients, suppliers and the public. We expect our employees to disclose and correct situations where C&T does not act in this manner.

Accordingly:

- C&T is committed to integrity in the workplace.
- C&T's commitment to excellence in data quality extends to, and includes all aspects of data production analysis, review and reporting.
- Any attempt by management or by any employee to compromise this commitment presents a serious case for disciplinary action.
- All C&T employees will immediately report to management any information concerning the possible or factual falsification or misrepresentation of data or any associated components. Falsification or misrepresentation of data includes (but is not limited to) the following:

    1. Intentionally altering an instrument, computer, or clock to falsify time records.
    2. Altering the content of a logbook or data sheet with the intent to misrepresent.
    3. Falsifying or misrepresenting the identity of an analyst(s).
    4. Changing raw data documentation with the intent to obliterate or eliminate data;
    5. Preparation or submittal of false or "faked" data packages or any components of data packages;
    6. Use of illegal measurement techniques, such as peak shaving or fraudulent data system settings for the purpose of bypassing QC procedures;
    7. Deliberately modifying/manipulating computer programs, spreadsheets, or other automatic data reduction tools for the purpose of bypassing QC or to misrepresent the data;
    8. Any attempt to falsify or misrepresent data or events as they actually occur in the course of data production review and reporting;

It is the responsibility of all C&T employees to report any situation that may impact the final quality of the data. All C&T employees have the obligation to discuss known or suspected violations of this policy with management, including the Group Leaders, Department Managers, QA Director, and Lab Director. C&T hereby affirms that all employees are entitled to report such third party activity without fear of censure or reprisal.

When an employee has a question on data quality, he or she should first discuss the matter with the Group Leader or Department Manager who is closest to the situation and who can be relied upon to supply the answers.

If the discussion with the Group Leader, Department Manager, or QC Chemist fails to resolve the situation, the employee should meet with the QA Director, Operations Manager or Lab Director. If the data quality question involves the Group Leader, Department Manager, QC Chemist, Operations Manager, or other managers, the employee should discuss the matter directly with the QA Director or Lab Director. The substance of the discussion and any resolutions should be documented in writing.

If a satisfactory resolution is not obtained, or if it is not possible at the level in which the situation is being reviewed, then the issue must be brought immediately to the QA Director and/or the President. It is the responsibility of the QA Director to promptly investigate all any reports of known or suspected violations of this policy. Management will respond in a timely manner to all employee concerns regarding data quality.

If an employee has a concern regarding a violation of the ethics and integrity policy:

1. Discuss the problem with the employees' immediate Group Leader or Department Manager.

2. If the issue involves a Group Leader or Department Manager, the matter should be discussed with the Quality Assurance Director.

3. The QA Director and Lab Director are responsible to resolve the problem within the scope of C&T's policies.

4. If the matter cannot be resolved at the QA Director's level, it should be brought to the attention of the President.

It is the responsibility of C&T to provide all employees with the facilities, equipment, and training to achieve the data quality objectives and ethical behavior goals stated in this policy.

It is the responsibility of C&T to provide our clients with documented and legally defensible data of known quality.

To reaffirm awareness of, and commitment to, the highest standards of data quality, excellence and integrity, each employee is to sign a statement of their "Commitment to Excellence in Data Quality". The original statement is maintained in the individual's personnel files. New employees are required to complete the statement at the conclusion of their orientation.

1.5 Confidentiality

The measurement data, reports, conclusions, and related information provided C&T to its clients or otherwise generated by C&T are always considered confidential. No third party has a right to obtain information from C&T pertaining to our clients activities or related information without 1) permission from the client, or 2) appropriate and relevant legal process (warrant or subpoena). Our employees may not provide any confidential information without an appropriate and valid reason, as outlined in C&T's SOP for Confidential Business Information.

1.6 Conflict of Interest

C&T recognizes that certain situations may generate conflict of interest between C&T and its client, and/or C&T and its employees. To minimize the risk of an appearance or actual conflict of interest, C&T will strive to identify relationships between itself and its clients, and its employees that may constitute a conflict. Specifically, C&T employees are not allowed to 1.) work for a direct competitor in any capacity, 2.) accept gifts, gratuities, or awards in excess of $100 valuation in a 12 month period from any client, supplier, or in excess of $200 valuation from all clients suppliers or agencies in a 12 month period, or 3.) work directly for a client of C&T in the same, or related capacities as work performed for C&T. The appearance of, or actual conflict, must be corrected by terminating either the client or the employment relationship with C&T.

C&T Commitment to Excellence in Data Quality

December 28, 1998

As a C&T employee, I have the right and responsibility to report any situation which may be adverse to quality or which may impact the final quality or integrity of data produced for our clients.

I will report immediately to management any information concerning the misrepresentation, or the possible misrepresentation, of analytical data (or any of its associated components). Examples include (but are not limited to): intentionally altering an instrument, computer or clock to falsify time records; altering the content of a logbook or data sheet with the intent to misrepresent; falsifying or misrepresenting the identity of an analyst(s); changing raw data documentation with the intent to obliterate or eliminate data; preparation or submittal of false or "faked" data packages or any components of data packages; use of illegal measurement techniques, such as peak shaving; and fraudulent data system settings for the purpose of bypassing QC procedures; deliberately modifying/manipulating computer programs, spreadsheets, or other automatic data reduction tools for the purpose of bypassing QC or to misrepresent the data; or any attempt to falsify or misrepresent data or events as they actually occur in the course of data production review and reporting.

I will not knowingly participate in any such activities, nor will I fail to report any such activities of which I become aware. I understand that if I knowingly participate in any such prohibited activity, I may be subjected to serious disciplinary action, up to and including termination for cause, as well as possible individual debarment against participating on contracts awarded by the Federal Government.

I will report any actual or suspected violations of this policy to management. I have read and understood the reporting procedures and ethics policy are described in detail in the Laboratory Quality Assurance Program and the C&T Employee Policy Manuals. I understand that I have both the right and obligation to discuss any violation, or potential violation, of the ethics policy with the Quality Assurance Director, the President, and/or the other channels of communication outlined in the policy.

_____

Print Name

_____ _____

Signature Date

F:\qc\qam_v7\ethics.doc

2.0 SCOPE AND PURPOSE OF THE QA PROGRAM

2.1 Content

Curtis & Tompkins, Ltd. (C&T) provides a broad range of analytical testing services to industry, public utilities, engineering firms, and other private and public sector clients. This Quality Assurance Manual (QAM) describes in detail the measures taken by C&T to ensure the reliability of the analytical data produced in the laboratory. Approved technical and procedural standards are a corner stone of our approach. C&T relies on, and requires, the participation of all employees in the quality program to meet our goal of providing clients with technically and legally defensible data.

This Quality Assurance Manual (QAM) describes our QA Program (QAP) and is one of many documents that are used by C&T to ensure quality work. This manual describes the program as it is implemented within the laboratory. The other documents and tools of C&T's quality assurance program include Standard Operating Procedures (SOPs, a tabulation more than seven volumes totaling hundreds of distinct procedures appears in Appendix_2), and client-submitted Quality Assurance Project Plans (QAPPs) and Sampling and Analysis Plans (SAPs).

At C&T, quality is defined as adherence to specifications. In the world of analytical chemistry, the QA Program is aimed specifically at procedures for control of common errors such as false negatives, false positives and misquantitations. Implementation of the QAP ensures appropriate, accurate and complete documentation of all events related to the measurement process including adherence to specifications for accuracy, precision, and completeness of the measurement data.

C&T has a policy of establishing quality specifications that encompass limits and acceptance criteria for calibration events, accuracy (spikes), precision (duplicates), control samples for false positives (blanks) for every measurement procedure employed in its laboratories. This manual does **not** contain quality control specifications for the various testing products that are offered by the laboratory. These specifications are contained in the standard operating procedures for each specific testing method. References to specific documents, including revision status, and date implemented containing these specifications (SOP's) appear in Appendix_2 of this manual.

2.2 Purpose

An established QA philosophy and program are essential for consistent production of valid data. The QA program ensures that all data generated, reviewed, and reported are produced and interpreted by trained, capable people following appropriate procedures.

Quality Control includes the specific checks and measurements within the QA framework, which are used to assess both the measurement system and the quality of the data, produced. The specific QC requirements for each analytical procedure can be found in the appropriate SOP, but the program guidelines are established in this manual. Project specific QC requirements are established using QAPPs and SAPs, and will not be addressed in this manual except to state that when these requirements are in conflict with C&T's quality

assurance program the client's requirements take precedence (if known prior to analysis of the samples).

This QAM establishes the standards that C&T adheres to and provides mechanisms to:

- Document the precision, accuracy, representativeness, comparability, and completeness of the analytical measurement systems and the data produced.
- Recognize deficiencies quickly and provide an efficient mechanism for correction.
- Monitor and control the management of data and to document its validity.

2.3 Objectives and Scope

The objectives and scope of the quality assurance program include:

- Scheduling of independent review and audit of all technical procedures.
- Coordination of QA and QC procedures that provide a documented, consistent level of quality for environmental measurements.
- Responsibility for documentation of all data generated, stored, and reported as technically valid and legally defensible.

3.0 ORGANIZATION AND RESPONSIBILITIES

3.1 Organization

Curtis and Tompkins, Ltd. consists of one laboratory located in Berkeley, California. The laboratory is organized to facilitate sample management, analytical performance and management, and data reporting and management. The laboratory is fully staffed, including a QA Director who reports directly to the President concerning quality issues. This ensures the autonomy of the quality function because responsibility for operational and profit loss performance is entirely separate, and belongs to the Operations Manager. The corporate structure appears as an organization chart in Figure 3.1.

3.2 Responsibilities and Authority

Quality Assurance is supported at the highest corporate level by C&T's President and Laboratory Director, who is also the sole stockholder in the corporation. Recognition and support of QA at this level is of paramount importance to ensuring its effectiveness.

Development and implementation of QA policy within the laboratory is delegated by the President to the QA Director. The following positions in C&T's organization have specific responsibilities for the implementation of the QA Plan at C&T: Quality Assurance Director, Quality Control Chemists, Department Managers, Group Leaders, Project Managers, Chemists and Analysts. The responsibilities of the 'Technical Director' outlined in the NELAP standard are divided among the Laboratory Director, Quality Assurance Director, and Operations Manager.

Lab Director is primarily responsible for the application and development of the Lab's resources to meet or exceed current and future client requirements. The Lab Director's responsibilities encompass the general business management of the laboratory, and all its resources, including equipment, facilities, and personnel. Other responsibilities include, but are not limited to:

- Implementing corporate programs and directives for Personnel management, Quality Assurance, Financial and Resource Management.
- Training and development of the staff into an efficient and effective team.
- Strategic and Operational Planning
- Business development and overall client service satisfaction
- LIMS planning and systems development

Temporary or long-term absence of key personnel

Employee leave, travel, training, illness, and client meetings are normal reasons for staff to be absent from the lab. The Laboratory Director is responsible for assignment of responsibilities to any individuals at the laboratory. The procedure for making these assignments is based on the situation and duration of the absence, with the exception of assignment of those tasks related to the Quality Assurance Director. In particular, the

authority to independently stop work in response to a quality problem must be documented, to provide the individual to whom the responsibility is assigned the necessary organizational authority to execute this authority. For this reason, responsibilities of the Lab Director shall be assigned to the Quality Assurance Director the in the absence of the Lab Director, and vice-versa. The reassignment of responsibility for any key personnel shall be documented by memo to the individuals personnel file maintained by the QA Director.

QA Director is responsible for proactively managing the consistent, incremental improvement of C&T's services. Responsibilities include the quality of management systems, as well as data/product quality systems at the laboratory.

The QA Director has dual "core" responsibilities. The QA Director is responsible for data quality control by insuring the "first time" production and compliant documentation of the chemical measurements at the laboratory. The QA Director is also responsible for designing and implementing improvements in managerial systems that improve data quality, and operational effectiveness and efficiency. Other responsibilities include, but are not limited to:

- developing, implementing, and reviewing QA policies,
- identifying, reporting, and coordinating the resolution of QA issues, including stop work authority in response to quality problems,
- conducting performance reviews and audits,
- documenting and reviewing personnel training,
- providing training to all personnel regarding QA and QC policies,
- implementing QC procedures, monitoring the QA/QC standards of performance, and monitoring validity of the data generated by the laboratory,
- promptly investigating any reports of known or suspected violations of the ethics and integrity policy.

The responsibilities of the Quality Assurance Director shall be delegated to the Laboratory Director in the absence of the Quality Assurance Director.

Operations Manager is responsible for the day-to-day operations of the laboratory. The Operations Manager's primary goal is insuring, through both managerial and direct effort, the timely & profitable production of chemical measurement services. Other responsibilities include, but are not limited to:

- assigning and clearly communicating operational priorities,
- allocating daily resources,
- supervising Project Managers and Department Managers,
- ensuring that sufficient number of qualified employees are employed to perform and supervise the laboratory's work,

- assisting in employee performance reviews and audits,
- overseeing subcontractors and implementing subcontracting procedures,
- estimating laboratory capacity and projections.

The responsibilities of the Operations Manager shall be delegated to the Department Manager of the Client Services group in the absence of the Operations Manager.

Information Systems Manager is responsible for equipping and maintaining a well trained and informed staff to meet the expectations of C&T's clients and its management, by efficiently and effectively acquiring and storing information in easily retrievable structures and systems. Other responsibilities include, but are not limited to:

- documenting LIMS utilities and programs,
- controlling LIMS security and access,
- validating software,
- developing & implementing systems to control data integrity,
- maintaining audit trails for data changes.

Department Managers at C&T equip and maintain a well trained and informed staff to meet the expectations of our clients by efficiently and profitably generating defensible data on time. The tasks specifically attributable to Department Managers in the implementation of the QA Program are specified below under each of their five defined core management responsibilities:

- Planning:
  Setting management goals & objectives
- Staffing:
  Training a staff of up to 15 analysts in key technical skills, e.g., instrument & software operations.
  Providing documentation of training efforts and PE/LCS sample analysis
  Providing performance feedback to employees on their QA responsibilities.
  Orienting staff to QA responsibilities & procedures within their group
- Organizing & Directing:
  Assigning staff to complete tasks and projects related to QA Plan implementation
- Controlling:
  Reviewing data for compliance & completeness, implementation of the peer review process within their group.
  Writing and updating SOP's, and ensuring that current SOP's are available to Chemists & Analysts in their group and at their workstations.

Ensuring the correct and complete implementation of the benchbook, run log, and maintenance log procedures.
Ensuring compliance with the calibration standards tracking and control procedures within their group
Initiating and completing corrective action procedures, as needed.

- Technical Functions:
  Ensuring the implementation of preventative maintenance procedures for instruments and equipment.

Generally, Department Managers are responsible for understanding, communicating specific requirements to chemists and analysts in their group, and ensuring compliance with QAPPs and specific aspects of C&T's QA Plan. They ensure that all data produced in their group complies with all C&T specifications for technically and legally defensible data.

Quality Control Chemists are senior level chemists with experience in the laboratory as an analyst, laboratory Project Manager, or consultant/ engineer project chemist. QC Chemists may be temporarily assigned by the QA Director to perform Department Manager functions in the event of short absences. QC Chemists are primarily responsible for the following tasks:

- Data Review: Performing data review to assure lab data meet SOP and project specific requirements and assuring adherence to lab documentation practices.

- QAPP Review: Review project plans against C&T capabilities during bidding process and after award of contract. Entering client- and project-specific information into the LIMS databases. Assist Project Managers with data validation questions.

Project Managers are responsible for the interface between clients and the laboratory. Accordingly, clear communication to all constituents, including clients, Department Managers, QA & Lab Directors, analysts and field technicians, is their most important responsibility.

- Clearly communicating client requirements specified in QAPPs and elsewhere to all affected individuals within the laboratory. Obtaining, by appropriate means, the required commitment of all relevant individuals to understand and agree to meet client requirements.

- Informing Lab and QA Directors of situations and issues, and recommending actions required to meet client needs and expectations.

- Reviewing data packages submitted by Department Managers for compliance to Client requirements and QAPP specifications.

- Communicating, in a clear and timely manner, the status of work to clients either verbally or through written reports such as case narrative or project management reports.

Group Leaders at C&T are analysts who have demonstrated the interest and ability to organize, schedule, and train other analysts in a specific analysis (i.e.: TPH-Diesel) or range

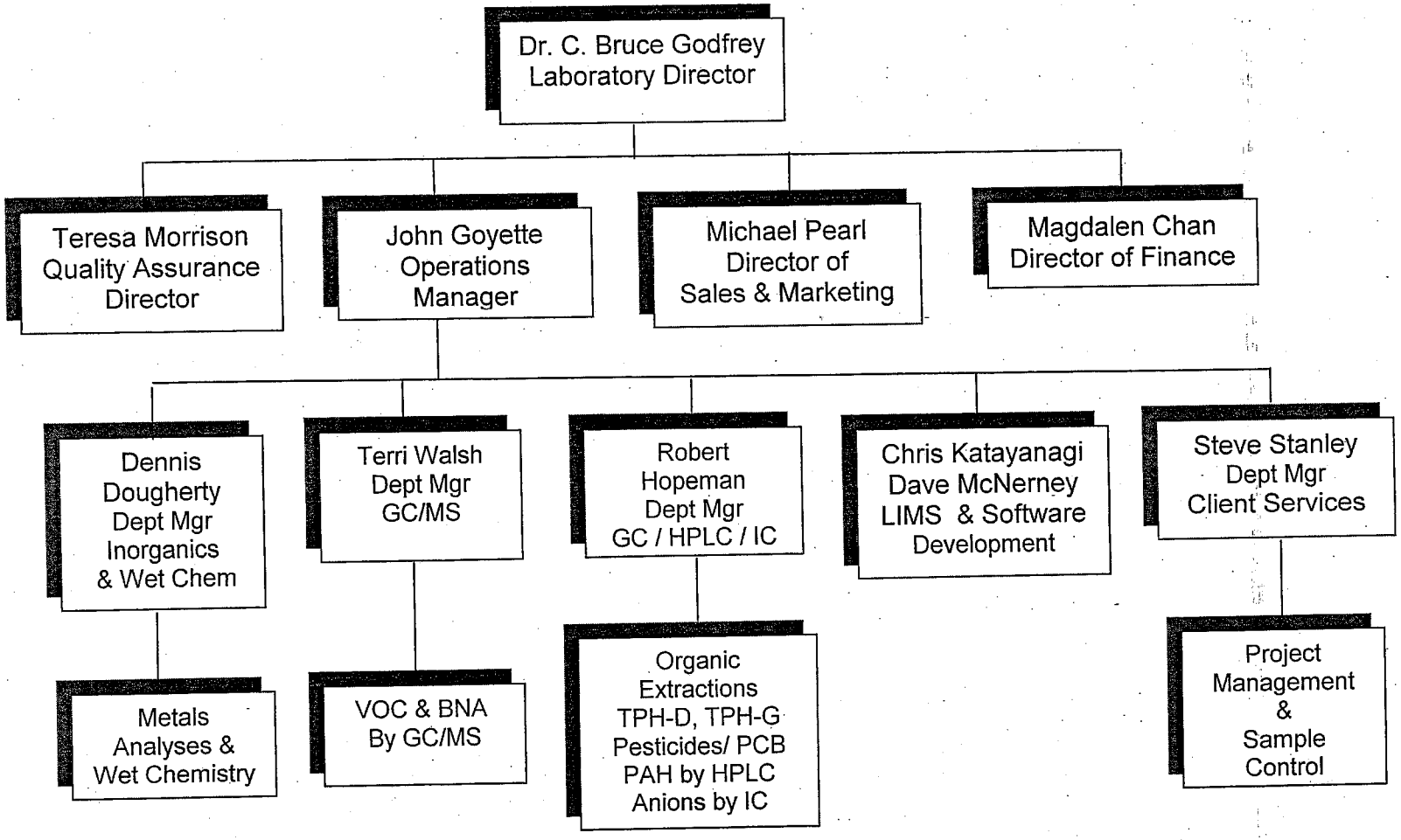
of related analyses (i.e.: wet chemistry analyses). They are responsible for assisting the Department Managers to which they are assigned improve the productivity and quality of the data produced by the department by:

- Scheduling and assigning daily tasks, and performing peer-level data review for compliance to established SOP and QC procedures and requirements,
- Assisting in training less experienced staff,
- Initiating and completing corrective action procedures, as needed.

Chemists and Analysts are responsible for understanding and applying QA and QC procedures in the areas in which they are assigned, and for seeking clarification as needed. C&T's QA Plan relies primarily on the ability of individuals performing analyses to do so in a manner that is technically and legally defensible. This demands attention to detail and a thorough understanding of the analytical process. Analysts receive formal orientation in the laboratory's QA Program within their first 90 days of employment. As part of this process the following responsibilities are clearly communicated:

- Clear, legible, and compliant entries into all benchbooks. Compliance with all procedures and specifications detailed in the SOP for Benchbooks entries.
- Clear, complete, and compliant documentation of all significant events in the measurement process is a requirement. Significant is meant as any step required to reconstruct the process after the fact, in order to detect an error or to demonstrate compliance to procedure.
- To obtain from Department Managers, Group Leaders or peers, a clear and complete understanding of QC compliance criteria for the tests and procedures they are performing.
- To inform Department Managers, Group Leader or peers of their understanding of any situation which is out of compliance with the QAP such that corrective action is initiated, if required.

Figure 3.1 C&T Organization Chart



Curtis & Tompkins, Ltd.

4.0 PERSONNEL QUALIFICATIONS & TRAINING

Technically and legally defensible data can only be produced by well-trained personnel who are adequately educated in their technical and managerial areas and in QA/QC procedures. Specific requirements for key personnel are outlined below.

4.1 Lab & QA Directors, and Operations Managers Qualifications

The minimum qualification for QA Directors, Laboratory Directors, and Operations Managers are:

- A bachelor's degree and three years of experience in a related field, or a master's degree and one year of related experience (three additional years of experience can substitute for the bachelor's degree).
- Proven communication skills.
- Proven management skills.
- Knowledge of the laboratory's technical and business regulations.
- Laboratory Directors must have three years of experience directly related to laboratory management.

4.2 Department Manager & QC Chemist Qualifications

Department Managers & QC Chemists must have the following minimum qualifications:

- A bachelor's degree and three years experience directly related to the activity they are supervising.
- One year of managerial/supervisory experience or two years of active participation within the existing group.
- Strong communications skills.
- Knowledge of applicable methodologies and systems under which the group routinely operates.
- Technical skills in computers and/or instrumentation relevant to the department they are supervising.

4.3 Analyst, Chemist, Group Leader, and Project Manager Qualifications

Analysts, chemists, Group Leaders, and Project Managers will range in experience from entry to senior level. We seek entry-level employees for chemist and analyst positions and then train them according to procedures and practices outlined in later sections of this chapter. We seek entry-level chemists and analysts with the following skills and background:

- A bachelor's degree in chemistry or a related discipline.
- Strong communications skills (particularly about technical issues).
- Strong commitment to quality and teamwork.

4.4 Classroom Training

The quality of our results, responsiveness to customers, and production efficiency throughout the organization depends on the competency of our staff. We address the C&T

mission statement "for the professional satisfaction of our staff" by committing resources toward the training and development of our people.

C&T has developed a training program that outlines curricula and processes for formal training classes in the following areas:

- New employee orientation
- Ethics and Integrity
- QA/QC Training
  Fundamentals 1: Intro to QA Program
  Fundamentals 2: Batch QC
  Fundamentals 3: Calibration
  Benchbooks, Logbooks and Documentation
  Computer chromatographic integration procedures
- General methods and specific analytical procedures
- Performance Management
- Communication Skills
- LIMS System
- Laboratory Health & Safety

The training files identify specific resources, course content, and outside workshops and meetings which have been approved for use in the development of our staff.

Periodic training is conducted to ensure that all employees maintain knowledge of current issues and practices in the laboratories. Selected personnel participate in managerial, QA/QC training or technical seminars, workshops, and professional organizations.

4.5 Functional Skills Training

In addition to the classroom type of training outlined above, C&T has developed a workstation approach to laboratory skills training. Each group in the laboratory is broken down into workstations, which typically comprise one analysis (for example PAHs by EPA 8310), but may comprise many test methods (for example wet chemistry workstations). Workstation skills criteria have been developed, with training and performance milestones. Typically Department Managers are responsible for providing training, however, in many instances Group Leaders and peers provide training at each workstation. Performance criteria to demonstrate chemists' competence to perform analyses at each workstation have been or are being developed. These criteria include an initial demonstration of proficiency consisting of the successful analysis of four consecutive laboratory control samples. Ongoing proficiency is demonstrated by annual analysis of a performance evaluation sample, a method detection limit study, or repetition of 4 consecutive laboratory control samples.

4.6 Other Training

We at C&T are committed to providing the necessary training to ensure that our employees are abreast of changes in technology, QA procedures, and relevant environmental regulations. "Right to Know" and Hazardous Communication Programs are administered under the Safety Program and field personnel are required to complete all appropriate training (for example, OSHA 40-hour Hazardous Operations Certification).

4.7 Training Records

The QA Director has a responsibility to ensure the lab staff takes advantage of C&T's training resources and programs, and to maintain records of each individual's training. Individual training records document classroom training events, method proficiency demonstrations (PE/LCS Sample results), trainer, date of training and any other required or additional training.

5.0 FACILITIES, EQUIPMENT, AND SUPPLIES

5.1 Laboratory Design

Curtis and Tompkins' laboratory was designed for safety and to prevent contamination of samples, and is fully equipped to perform a wide variety of environmental analyses. The use of appropriate, well-maintained facilities, equipment and supplies is fundamental to the production of high quality data.

5.2 Facilities

Curtis and Tompkins maintains a 23,500 square foot laboratory. Figure 5.1 presents a floor plan of the facility.

It is C&T's policy to maintain reasonable and strict security at its facility. C&T maintains security of proprietary information by implementing access control procedures designed to insure that only authorized individuals have access to:

- samples in storage, preparation, and analysis,
- all computer systems,
- data files and paper files containing results of sample & control analyses,
- confidential and proprietary information, and
- maintenance of audit trails for data changes in manual and automated systems

C&T documents these procedures in standard operating procedures (SOPs) for LIMS, computer systems, facilities, and sample control.

5.3 Equipment

C&T uses state-of-the-art equipment for processing samples and data, appropriate to the procedures employed. The proper and acceptable performance of our instruments and measurement equipment is of paramount importance to implementing a measurements Quality Assurance program. Procedures for calibration and maintenance of instrumentation ensure that our clients receive technically and legally defensible data. Method- or instrument-specific procedures are detailed in appropriate SOPs. C&T guidelines and method specific criteria established in the SOPs require that each instrument be calibrated with traceable reference materials, which are checked against a second source to prevent quantitation errors. Manufacturer recommended maintenance is performed and, where applicable, specific performance criteria are measured and documented at specified intervals.

SOPs have been developed that establish a system of instrument maintenance and analysis logs to track calibration events, equipment utilization, and samples processed on each instrument. This system allows maintenance and calibration events to be documented for each instrument, and provides instrument operators with historical information needed to quickly solve maintenance problems and conduct repairs. Critical parts inventories and preventative maintenance procedures are incorporated for each instrument system throughout the laboratory.

SOPs have also been developed that establish calibration frequency, acceptance limits, correction factors and other corrective actions for minor laboratory equipment, such as thermometers, balances, ovens, hot plates, and fume hoods.

C&T's LIMS system contains a comprehensive database of all equipment in use at the laboratory. The database treats each instrument as a system comprised of a collection of assets. Each asset is a discrete piece of equipment that can typically be inter-changed with others of like kind to comprise another similar system. As example is a VOC GC/MS analysis system, which is comprised of assets including a Gas Chromatograph, a Mass Spectrometer, Purge & Trap Sampler, and possibly other component assets such as a stand-alone PC data station. The equipment files contain detailed information on each component asset, including manufacturer, model number, serial number, lab and room location, date entered into service, and date retired if applicable.

Each instrument system at the laboratory has a unique identification and number which allows users of the LIMS system to identify the instrument used to analyze a sample or batch of samples. This electronic tracking system is a powerful adjunct to the system of bound instrument (run) logs and maintenance logs described above. The instrument ID system is a key to the sequence number ID system employed by C&T's LIMS which generates a unique ID number for every measurement processed by the LIMS. The 12-digit sequence number specifies the instrument system ID, date, time and temporal order relative to related measurements and calibration events.

Systems have been designed to use this electronic equipment database to schedule preventative maintenance events, automatically track calibrations, and list all samples, QC samples, and calibration events processed by individual instruments.

A summary of laboratory equipment is included in Appendix 3. Contact the laboratory if you require other information about our instrumentation and equipment.

5.4 Data Management Systems

Curtis and Tompkins has developed an advanced system of integrated local area networks (LANs) of computer hardware to automatically collect, reduce, and distribute information and data throughout the laboratory. This integrated Laboratory Information Management System (LIMS) utilizes advanced distributed processing technology between UNIX, and MS-WINDOWS based operating systems. The core of the LIMS system is a relational database UNIX/ORACLE network that provides sample-tracking, a results database, custom electronic and hardcopy reporting, and data management services.

QA for Laboratory Information & Data Management Systems

C&T has designed and implemented a comprehensive complex computer network Laboratory Information Management System (LIMS) for the automated collection, processing, quality control, storage and archival of laboratory data. The primary functions of the LIMS are to provide rapid, automated access to all data that is relevant to the measurement processes, and to automate as far as possible the data quality control and validation processes. This section describes specific quality assurance practices governing computerized data management, which are crucially important to insuring the accuracy and integrity of our laboratory data.

The goals of C&T's LIMS QA program are:

- To insure computer processes and specific programming steps are appropriately and sufficiently documented.
- To insure that electronically reported and stored data reliably represent test results.
- To insure test results and other critical data are secure from unauthorized or inadvertent changes.
- To insure that automated data collection reduction and storage processes are in substantial compliance to government agency and industry recognized standards for ensuring data integrity in automated laboratory operations.

C&T's LIMS QA program is based on the following principles, which define the necessary control issues underlying the automated collection and processing of laboratory data:

DATA: Data corruption can occur at any stage from collection to recall. Acceptable programming control systems must provide evidence of reasonable protection from data corruption.

- FORMULAS: Formulas and programs must be verified by inspection. It is not safe to assume that test or decision criteria are correct.
- AUDIT: Critical transactions and processes should be designed with audit trails for logging transactions. The audit trail generally uses a password or equivalent to identify the responsible users or person(s). The LIMS components and system should be periodically inspected in-depth from raw data through final report.
- CHANGE: Program and process changes are a routine part of LIMS development and evolution, and must be documented. Change control procedures capable of tracking system operations, hardware and software changes should be established. Change procedures should include pre-installation test protocols and appropriate document update routines.
- STANDARD OPERATING PROCEDURES (SOPS): Routine LIMS procedures are appropriately documented. These SOPs are for user training, and available, appropriate user documentation.
- DISASTER: System controls must incorporate planning for unusual events and system stresses. These include back-ups for prolonged total system failure, disk crashes, routine archiving, CPU and power supply failures.
- SUPPLIERS & VENDORS: Laboratory instruments, data reduction systems, hardware, and/or software should meet agency guidelines (i.e.: EPA's June 1990 draft US-EPA document: Automated Laboratory Standards, A Guide to EPA Requirements for Automated Laboratories or US-EPA-GALP's) for design, support, notification, and documentation criteria for the items they supply.

The LIMS QA program and all associated files are maintained by the [illegible]tory Quality Assurance Director, and implemented by LIMS Developer and staff.

5.5 Supplies

Curtis & Tompkins is dependent on suppliers' capabilities to manufacture and deliver necessary items in a timely manner which conform to product specifications as agreed to by both parties. It is the Department Manager's responsibility to monitor supplier performance on these issues, ensure that incoming reagent checks and instrument verification are completed as needed, and to initiate corrective action in the event of a performance failure.

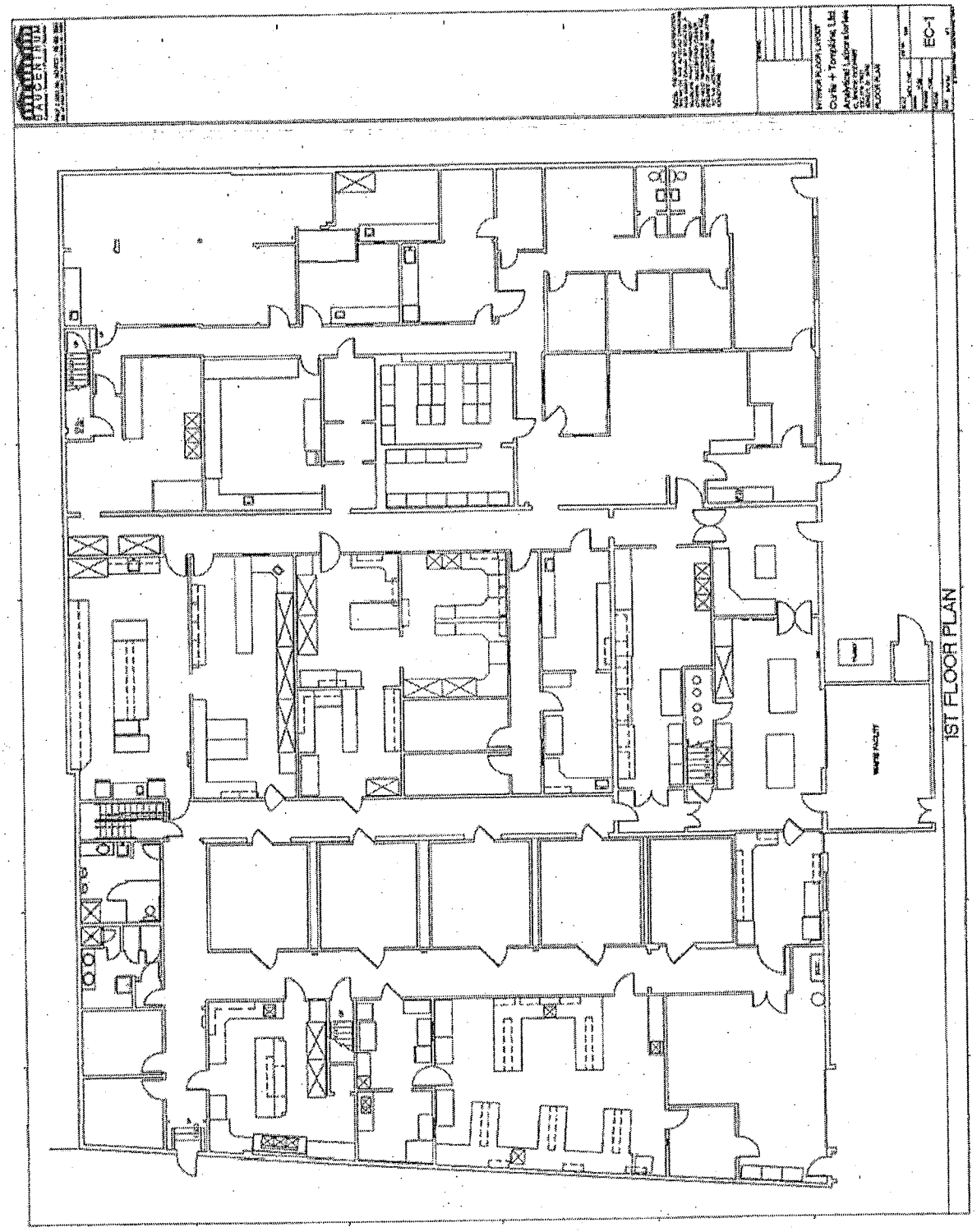
Specific procedures have been written and implemented for screening solvents and reagents used in the measurement process. The screening of these supplies insures that they do not contribute artifacts that influence the measurement process. The screening of solvents and reagents, as well as the manufacturer and lot numbers of reagents and solvents, are recorded as part of the measurement process.

5.6 Preventative Maintenance

Preventive maintenance is vital to the proper operation of analytical instruments and laboratory equipment. Routine, documented maintenance prevents unscheduled downtime and missed holding times or client due dates. It also increases the life span of most equipment. Some instruments and equipment at C&T are under service contract with outside suppliers or manufacturers. Routine maintenance tasks and intervals have been established for many of the instruments employed in C&T's laboratory. Maintenance schedules and tasks for each instrument are maintained in bound instrument maintenance and run logs if applicable. Preventative maintenance, if performed by C&T personnel, is the responsibility of analysts and Department Managers. The documentation that maintenance has been performed, and at what interval, is to be available in the laboratory at or near the instrument, and available for review by the QA Directors, auditors, or others.

Written SOPs and other procedures for preventative maintenance have also been established for smaller equipment such as balances, pH meters, automatic pipettes, from larger more capital intensive equipment like ICP Spectrometers, and Gas Chromatographs.

FIGURE 5.1 **Curtis & Tompkins Floor Plan**



6.0 SAMPLE CUSTODY & SAMPLING

Data generation and processing begins in the field and procedes in much the same manner as a physical sample through the laboratory. The data flows from one part of the laboratory to the next, with reviews at each stage. This chapter deals with the flow of data through the laboratory.

6.1 Sampling Procedures

C&T provides sample containers for many of our clients, in accordance with EPA requirements for container type, size, and preservation. Laboratory SOPs for container preservation and traceability have been developed to ensure compliance with regulatory compliance. Technical assistance is available to our clients from the C&T Client Services Group as needed. Appendix 1 lists appropriate sample size, container type, preservation and holding time requirements for most parameters, for both liquid and solid matrices.

The C&T Client Services Group may occasionally be asked to perform a sampling event. In these instances, a Sampling Plan is prepared and approved by the Project Manager and the client prior to sample collection. Sample Control personnel are appropriately trained in these activities and receive the appropriate certifications (e.g., OSHA 40-Hour) prior to conducting a sampling event.

6.2 Sample Custody

All samples collected by and/or received at C&T are considered to be physical evidence and are handled accordingly. The possession of samples is traceable from the time of sample collection until their final disposition. A sample is considered "in custody" when:

- It is in your actual possession.
- It is in your view after being in your possession.
- It is in a secure area.

The Sample Control Standard Operating Procedures define specific procedures for system and access controls, security, sample receipt, log-in, chain-of-custody, storage, and tracking throughout the analytical process. These procedures are briefly described below.

6.2.1 Sample Receipt

Sample shipments are received through a designated entrance at the laboratory. Sample Control Technicians verify the number of shipping containers being received against the number listed on the chain-of-custody before signing the chain-of-custody. Any damage to the shipping container(s) or other discrepancy is noted, either on the chain-of-custody or on a Cooler Receipt Form. A copy of this document is kept with the project file.

6.2.2 Sample Verification and Log-in

After a shipment arrives, a Sample Control Technician performs a sample inspection. C&T's Sample Control Checklist serves as a training tool and as a list of procedures to follow. The checklist is kept as documentation when it is used or, alternatively, discrepancies are noted directly on the chain-of-custody. Specifics of the inspection include:

- Presence/absence of custody seals or tapes on the shipping containers and the condition of the seals (intact or broken)
- Presence/absence of a chain-of-custody

- Presence/absence of sample tags or labels
- Agreement between sample tags, the chain-of-custody and any other client documentation
- Condition of the samples when received (e.g., cold or ambient; intact, broken or leaking; headspace in VOA vials; etc.)
- Appropriate sample size (i.e. sufficient volume for analyses)
- Correct sample preservation (volatile samples are checked immediately after analysis, not upon receipt).

If everything is acceptable, the chain-of-custody is signed as verified. Any discrepancies are noted and the client is immediately notified. No work proceeds until the problem is resolved.

All samples are entered into the Laboratory Information Management System (LIMS) when they are received. A unique C&T laboratory number is assigned to each sample group and a sequential sample number is assigned to each sample container within that group. The client's name, account number, location, telephone and facsimile numbers, analytical request, date received, and report due date are entered into LIMS. A printout of this information is immediately generated and attached to the client job jacket. The Project Manager then reviews the login summary and stores the job jacket in data management's active file until all analyses are completed.

6.2.3 Sample Storage and Tracking

After sample log-in, all samples are labeled with the laboratory number and the unique container number, and stored under refrigeration at 4°C. Aqueous samples for volatile organic analysis are stored in a separate refrigerator. All sample storage locations are documented.

All analysts and chemists follow internal chain-of-custody procedures to further ensure the validity of all data. All samples are signed out in the Sample Custody Log when they are removed from the refrigerator for analysis. The sample number, date, and analyst initials are recorded in this log. When samples are returned, the date, time, and analyst's initials are again recorded. Chain-of-custody is maintained for sample extracts and digests through signatures in the extraction and digestion records.

6.2.4 Sample Disposal

Samples are disposed of in accordance with the sample disposal SOP approximately thirty days after the final report date unless otherwise requested. The disposal date is recorded for closure of chain-of-custody. Samples are always disposed of in proper manner. The Laboratory Director is responsible overall for the safe and legal handling of all lab waste streams, including waste or residual samples. Sample Control Technicians are responsible for assisting the Laboratory Director in implementing these procedures.

Whenever possible, clients are requested to take back their samples. Transportation of the samples shall be arranged to insure proper safety precautions have been taken. If this is not possible the samples shall be classified according to the procedures listed below. The residual portions of all soil, water, wastewater, and industrial waste samples are considered hazardous and/or toxic for the particular testing characteristics for which they were submitted.

The hazardous and/or non-hazardous status of all classified waste samples is determined according to Federal, State and Local regulations and exemptions. Residual portions of waste samples are stored in appropriate designated sample storage areas until samples are designated to be disposed (i.e.: walk-in or Delfield refrigerators). Once designated for disposal, residual samples are stored at the laboratory waste storage facility, where they are drummed appropriately,

transported off site, and disposed of properly. Waste samples are stored in proper containers, eliminating or minimizing the possibility of incompatible wastes contacting each other. Waste sample containers are clearly labeled on the top of the container as to their content and status. If either the content or status is unknown, a reasonable explanation of the nature of the wastes shall be clearly visible on the container.

All sample waste transported off-site is properly manifested, and appropriate records are maintained to document the disposition of the waste when it leaves our facility. The Sample Control Technician is responsible for these activities. The Sample Control Technician is responsible for selecting a TSD facility or similar service for all sample wastes handled at the laboratory. Names of qualified suppliers are filed and accessible. Waste treatment, storage, and transportation to a TSD facility is fully documented and these records will be stored for five (5) years.

Waste risk management and prevention are the practice of the company. Staff is regularly trained in waste handling practices. Standard Operating Procedures (SOPS) describe the handling of individual waste streams and unique situations. Emergency response plans have been developed to deal with contingencies of accident and uncontrolled hazard due to laboratory waste.

6.3 Sample Extracts and Digestates

It is C&T's policy to regard all sample extracts and digestates that are "current" with respect to holding times as active samples. The storage of these extracts and digestates is controlled using procedures identical to those described above for samples.

Once holding times for sample extracts and digestates have expired, these sample derivatives are stored, handled, treated and disposed of as described for samples above, and in accordance with procedures defined in Facilities SOPs for each waste stream which the sample derivatives represent.

6.4 Subcontract Laboratory Services

Periodically, C&T has a need to subcontract chemical measurement services which we either 1) do not perform, or 2) are not appropriately certified to perform, or 3) do not have available capacity to perform. When it is necessary to subcontract services the Operations Manager is responsible, through the Client Services group, for the implementation of the procedure as specified in the Subcontract Lab SOP. Clients shall always be informed when C&T uses a subcontract lab.

A list of qualified subcontract labs, and the specific analyses for which they are used, is generated and maintained in the LIMS Seedpak Management Menu under Subcontract Labs. Subcontracted samples are logged in and treated identically to samples processed in the laboratory. Client identity, confidentiality, and custody procedures are strictly maintained. All subcontract labs must be specifically certified and/or accredited to perform the requested procedures required. Evidence of laboratory certifications and accreditations are obtained and filed before the labs are used. Relevant certification programs include but are not limited to, all state certifications, NFESC (Navy), USACE-MRD (Army), AFCEE (Air Force). If applicable, subcontract lab QA Manuals should be obtained and filed at the laboratory. For designated projects, subcontract labs should receive QAPPs, agree to meet project and/or site specific PQL's , reporting conventions, and QC limits, and agree to provide appropriate documentation and information prior to receiving samples. As, and if, needed subcontract labs should be visited for a site review of their procedures. Where appropriate, complete data packages including QC sample data are requested from all subcontract labs.

7.0 PROCEDURES AND METHODS

Analytical methods employed at C&T are generally EPA or other compendial methods, or those specified in the Code of Federal Regulations (CFR) including those found in SW-846 Test Methods for Evaluating Solid Waste or other EPA manuals. At times, industrial methods are utilized to analyze for specific compounds or parameters for which no EPA methods exist. In these instances ASTM or other methods are used. Appropriate methods are used for air samples including NIOSH or other applicable sources. The laboratory Quality Assurance Director maintains documentation of the laboratory's method capabilities. The methods most commonly used by the laboratory are included in the Holding Times and Sampling Containers table presented in Appendix 1.

7.1 Adherence to Accepted Methods

C&T's policy is to adhere strictly to the letter and spirit of compendial methods published by regulatory agencies (USEPA SW-846), industry organizations (WPCF-SMWW), and standards organizations (ASTM or AOAC). Strict adherence to performance parameters specified in published, recognized, and accepted methods insures that our clients receive a defined and recognized product, which will be legally defensible.

Periodically, it is necessary to modify compendial methods to fit C&T's equipment, the sample type received or to accommodate client requests, or meet other requirements. It is C&T's policy that whenever methods are modified either in the performance, acceptance criteria, or in any significant manner, the method reference on the client report will reflect the modification and the modification will be described. Major method variances require approval of regional EPA offices, or adherence to recently developed performance based methods criteria developed by US-EPA.

7.2 Method Selection

C&T performs measurement services according to the methods that its clients request.
If the method(s) requested by the client is inappropriate, technically unsound, or if a substitute method will provide superior results, usability or service, C&T will recommend substitution. Project Managers are most frequently involved in method selection processes. The Operations and QA Directors are also involved in and responsible for this process. Method selection is guided by principles of data usability and the data quality objective process. C&T endeavors to recommend methods that provide the accuracy, precision, and regulatory defensibility required for the intended use of the data. It is C&T's policy to ensure that the labs clients are fully apprised of the utility of the data they purchase.

7.3 Calibration of Lab Equipment

The appropriate calibration of all instrumentation and equipment is crucial to the validity of measurement processes. All C&T analytical SOPs specify calibration procedures by instrument type, calibration frequency, reference standards, calibration acceptance criteria, and calibration documentation procedures. Specification requirements for calibration procedures and practices apply to all measurement process including instrumental (GC, GC/MS, ICP, etc) and general chemistry methods (i.e., volumetric, gravimetric, titrimetric, etc.)

Procedures for assuring that balances, refrigerators, ovens, automatic pipettes, and other minor laboratory equipment are operating within measurable tolerances are established; logs of these measurements are maintained by the designated group.

7.4 Source & Working Standards: LIMS Standards Utility

The acquisition, inventory, general preparation, shelf life, and use of calibration, surrogate, spike, and internal standards is documented and tracked. C&T has developed an electronic database utility within the LIMS for performing this task. Analysts are required to use this utility for documenting the source, concentration, and component identity of all calibration solutions used for measurement processes. References to registered lab benchbooks and page numbers are included in the database for details of solution preparation.

7.5 Documentation of Events & Activities in Lab Benchbooks

At C&T, benchbooks are defined as bound, paginated laboratory notebooks that contain raw laboratory data, notes, and records of activities performed by individual chemists, or groups. Benchbooks are a vital part of proper laboratory documentation procedures. The process of generating legally defensible data requires documentation of all steps in the measurement process. Computer printouts must be generated and cataloged to contemporaneously document measurement activities & information contained on C&T's computer systems. In the modern computerized laboratory benchbooks serve three primary functions:

- Benchbooks provide a means to independently document the validity of data entered or contained in the LIMS using hardcopy data linkages.
- Benchbooks provide a mechanism for documenting events, procedures and observations that are not easily, or not yet established in the LIMS.
- The integrity of control systems associated with automatic data acquisition and digital storage is continually open to question by many of C&T's data users. Benchbooks provide a means of data traceability that lawyers and other officers of the court can understand.

Benchbooks can be important tools for the training and development of chemists. By recording observations and events, benchbooks provide a ready reference to professional experience. Although the LIMS ability to link various data acquisition aspects of laboratory processes provides swift and comprehensive means of relating data to most sample preparation and data acquisition events, many other activities cannot be readily documented in the LIMS. Also, many clients require use of laboratory benchbooks to document activities and processes even if the practice is redundant in electronic systems.

7.5.1 Types of, and uses for Benchbooks

Benchbooks have several uses and users. The primary uses of benchbooks are:

- Sample Preparation. Customized Excel spreadsheets have been developed for many of the sample preparation procedures. These spreadsheets are printed on heavy-duty copy paper and assembled into a bound benchbook prior to use. Write-protected templates for these benchbooks can be found in the QA network directory.
- Instrument or Analysis benchbooks are stored at or near the workstation or instrument to which they are assigned. These typically function to record balance calibration, pH meter operation, DI water system performance checks etc.
- Maintenance Logs are used for recording any changes or adjustments to an instrument that are likely to affect performance, resolution, and/or detection of analytes. Examples include

repairs, preventative maintenance, configuration changes, detectors, columns, new lamps, source cleaning, and all other events of significance. The purpose of logging this information is to allow reconstruction of events for troubleshooting and error detection.

- Sequence Logs, Binders and all notebooks. Computer printed data is essential to the benchbook documentation process. Critical hardcopy reports are dated and signed by the analysts and their content is referenced in a bound notebook to a sufficient level to document the validity of data in the computer output.

- Calibration Standard Benchbooks are for recording the preparation of source, intermediate and working standard calibration solutions. These benchbooks are used for inserting (gluing) source standard certificates of traceability, content, lot # etc. A LIMS linkage exists for book number and page number for the preparation of each working standard solution and for the logging of sources standards. Additional information on the Benchbook to LIMS linkage can be found in the SOP for LIMS Calibration Standards. This SOP can be found in the QA SOP's and on the lab's internal web-browser.

- Personal benchbooks may be assigned to individual analysts to record events and activities on an ongoing basis.

7.5.2 LIMS Logging of Benchbooks

Each benchbook must have a unique number. The location, department, status (active or inactive), function or purpose, and assigned individual must be logged onto the LIMS. If the benchbook is inactive, its archived location must be logged.

LIMS Benchbook Database Field Definitions

NUMBER:	Unique number generated by the system for each book
DEPARTMENT:	Group or Department to which the book is assigned
INDIVIDUAL:	Responsible Individual
LOCATION:	Room number or shelf
DESCRIPTION:	Function, description of the book's purpose or content
STATUS:	Active or Inactive

7.5.3 Auditing Benchbooks

The benchbooks are audited as part of the periodic internal audit procedure, and more often as part of training activities. Compliance to LIMS logging, content, use, clarity and reconstruction testing, and archiving are monitored.

7.5.4 Archiving Benchbooks

Once a benchbook is filled up, the analyst making the last entry in the book, or the individual to whom the numbered book is assigned, is responsible for returning the book to the QA Director who is responsible for implementing the benchbook archival procedure. When benchbooks are removed from active service, the status is changed to 'archived' in LIMS and the archived location is designated. The responsibility for maintaining the integrity and storage of the book(s) is transferred to the QA Director or the QA Director's designee in the Client Services group.

8.0 DATA QUALITY CONTROL & ASSESSMENT

Quality assurance as practiced at C&T consists of quality control and data assessment procedures that are adapted to the specific procedures throughout the laboratory. The use of a general framework adapted to specific activities facilitates training and consistent data generation throughout the laboratory. Routine internal quality systems and data audits are employed to monitor the entire quality program.

The objective for implementing data quality control and assessment procedures is to insure that C&T consistently provides data that meets the quality requirements of its clients, and their data users. C&T's data quality assessment criteria are based on accuracy & precision measurements, are internally generated and documented, or specified in reference publications (i.e. US-EPA SW846); or specified in contracts the laboratory executes with its clients. Overall C&T's primary objective is to satisfy its clients needs and contractual requirements for data of known quality based on adherence to specifications for accuracy, precision, and completeness.

8.1 Quality Control Acceptance Criteria

C&T employs EPA references such as SW-846 and industry accepted standards such as Standard Methods for Examination of Water and Wastewater (SMWW) to determine the appropriate QC parameters and limits for each measurement system. Quality control limits and acceptance criteria have been established throughout the laboratory for calibration, accuracy, precision and completeness. Data are reviewed for compliance to these criteria. Often, because there are multiple uses for the data, several QC limits may apply for the same methods within a lab. Specific procedures for establishing control limits are detailed in the QA SOP for generating control limits. Data acceptability is assessed according to the following hierarchy:

1) Project/ Client specified limits,
2) Internal laboratory limits, and finally,
3) Method prescribed limits.

In all cases, laboratory specific limits are established at levels that meet or exceed method specific QC limits. It is C&T policy to rely on statistically generated QC limits unless contractually required to evaluate data on the basis of a project-specific work plan. Contractually specified criteria are identified and documented by the Laboratory Project Managers; these requirements are then transferred to the analytical departments as described in the Client Services SOPs. Project Managers then review completed reports against the contract requirements.

8.1.1 Establishing Internal Laboratory Control Limits

Control limits are established for all routine tests run at the laboratory. They are determined, in part, from statistical analyses of the results from replicate analyses of Laboratory Control Samples (LCS), and in part on the basis of acceptance limits established by the marketplace. Control limits are established as benchmarks to evaluate the acceptability of QC data generated by the laboratory. C&T monitors the results of LCS analyses to evaluate trends in precision and accuracy, and to comply with requirements dictated by its clientele. The laboratory bases control limits on statistically generated control chart, predictable and communicated needs of its clientele, and the historical ability of the laboratory to meet these limits.

8.1.2 Out of Control Data

Measurement data are considered out of control when the data exceed applicable QC limits. Corrective actions for out of control data vary by method and appear in method specific procedures. Out-of-control data for many methods are automatically identified by the LIMS system through real time and virtual real time QC "filters". Out-of-control events are also identified during data review by analysts, Group Leaders, Department Managers, Project Managers, QC Chemists, or the QA Director.

8.1.3 Control Charts

C&T does not use control charts, but relies on automated LIMS utilities to identify trends and out of control events. The LIMS software automatically collects and analyzes QC sample results, and compares the recovery to the appropriate control limits. The analysts and laboratory managers have access to this data as required. The LIMS can print tabular data and statistical analyses as defined above. Control charts can be generated from current LIMS data using spreadsheet programs if required. Out of control event reports can also be generated automatically by the LIMS.

8.1.4 Control Limits

For analysis of metals and organic compounds, method blank and laboratory control sample data are used to establish statistically derived control limits for surrogate and spike recoveries. The recoveries of all spike and surrogate compounds are collected and analyzed automatically by the LIMS. The mean and standard deviation of an array of determinations, for a specific analyte and method, are calculated by a LIMS utility. Control limits are based on the historical mean recovery plus or minus three standard deviations on either side of the mean, as detailed in the laboratory SOP for generating control limits.

For analysis of many inorganic parameters, control limits are based on method-specified limits and on limits specified by the laboratory's Department of Defense clientele, as these limits are widely accepted within the industry.

The QA Director is responsible for the generating, updating, and maintaining internal laboratory control limits. The LIMS System Administrator is responsible for maintaining the automated utilities (programs) for data collection, statistical evaluation, tabulation and updating limits (for "filter" programs) within the LIMS. The Department Managers are responsible for generating printed information at periodic intervals as needed to address documentation requirements for various contractor oversight, certification and recognition programs.

C&T policy for quality control consists of a tri-level assessment system, each level with its own set of quality control measurements. The three levels are the instrument, the analytical batch, and sample specific quality assessment. In some cases, only one or two of the levels apply, but this concept is widely applicable in the laboratory. The following sections explain each level.

8.2 Instrument Calibration Criteria

To ensure accurate and precise data, C&T must demonstrate its measurement systems are in working order. To this end, calibration criteria, various instrument performance criteria, and similar measurements are made to assess the ability of the instrument system to produce data of acceptable quality.

8.2.1 Instrument Initial Calibration Criteria

First, the instrument is calibrated using traceable standard reference materials. Specific performance criteria on linearity, or curve, response factors and similar measurements are established and adhered to for each analysis. After the initial calibration meets the criteria, a standard from a second source is analyzed at a mid-level concentration. This is an initial calibration verification and is done to ensure that the standards used to calibrate the instrument were reasonably accurate.

8.2.2 Continuing Calibration Verification

When the initial calibration is complete and verified, sample analysis can begin. For most methods, this includes the analysis of a specific number of samples followed by a continuing calibration verification standard that demonstrates that the instrument is still performing in a manner similar to when it was calibrated. An instrument blank analyzed to demonstrate that the instrument is free of "carry-over" or contamination is also part of continuing calibration procedures. This provides the analyst with regular feedback regarding the performance of the system and the need for maintenance or re-calibration. In addition to calibration verification many instrument systems have other performance criteria required to demonstrate the ability of the instrument to measure the analytes of interest. Examples of these performance checks would be the tune criteria for mass spectrometers or the endrin/dieldrin breakdown criteria for the organochlorine pesticide analysis.

8.2.3 Calibration Standards and Material

C&T has developed procedures for using its LIMS to document all aspects of the handling and verification of calibration standard materials. The procedures detailed in the SOP on Calibration Standards describe the use of C&T's LIMS Calibration Standard Database while covering the acquisition, inventory, general preparation and use of calibration standards, surrogate standards, matrix spiking standards, and internal standards.

Information on the source, purity, traceability, and preparation of all calibration materials at C&T are maintained in the LIMS. The LIMS calibration standards database records and tracks all calibration standards as two types: 1) source standards, those obtained from outside sources, and 2) working standards prepared from source standards which are generally the solutions used for calibrating instruments.

The procedure requires written records to document the correlation between unique preparations of calibration standard materials and the electronic records in the database. Full documentation of the preparation of working calibration standards is achieved by linking the intermediate and working standard preparation events to a specific page in a uniquely numbered bound lab benchbook. Certificates of authenticity, traceability and other information are glued into the benchbook pages, or stored in files referenced by the benchbooks. Manufacturer, lot number and other vital fields are recorded in the LIMS and in benchbooks. The LIMS tracks benchbooks through a LIMS Benchbook database utility so that all records are traceable electronically.

The LIMS calibration standard procedure allows all calibration standard solutions to be linked to sample analysis and Batch QC data through the batch number (described below). Similarly, through LIMS serial numbers (unique number for every event, analysis or calibration run through LIMS), all calibration events are linked to the calibration standard's unique ID #, and to the instruments which were calibrated. The LIMS links the unique ID's of all working standards, spiking solutions and the concentrations, identities, and traceability of the individual components to samples, QC samples and calibration events. C&T analysts can, through the use of LIMS tools, automatically perform the following operations:

- identify and invalidate outdated source & working standards
- perform calibration response factor calculations
- prepare calibration reports and statistical evaluations
- calculate surrogate recoveries
- calculate spike/duplicate recoveries & precision data
- prepare calibration standard ID reports for data packages
- track calibration performance of instruments

The calibration materials system requires the date received for all source standards to be recorded and assigns an expiration date based on shelf life for materials. The preparation date for all working and intermediate standards is similarly required by the system to assign expiration dates on the earlier of the date the source expires, or the date the working standard expires.

The shelf life of source and working standards is determined from technical considerations including solution stability, known chemical degradation rates and pathways, data available in chemical references (i.e. Merk Index, CRC Handbook), storage conditions, and practical experience with the materials. The shelf life is established by Department Managers with the consent and approval of the QA and/or Lab Director. Generally, source standards are stable and can be assigned a life of several years, but no longer than 10 years. The shelf life of all source standards determines the shelf life of the working standards. A working standard expires on the day a source standard for the component expires; working standards cannot outlive the source standards from which they were created.

8.2.4 Criteria used to evaluate calibration events

In general, an initial calibration (ICAL) must be performed whenever instrument conditions have been altered or the daily calibration no longer passes acceptance criteria. Acceptance criteria based on the Relative Standard Deviation (RSD) of the ICAL response factors (Rf) or linear correlation coefficient pertaining to each compound of interest is reduced in statistical format. Individual method procedures specify the calibration acceptance criteria and calculations in detail.

For ongoing calibrations, criteria based on % Difference (%D) have been established for Initial Calibration Verifications (ICV) and Continuing Calibration Verifications (CCV). Individual method procedures specify the calibration acceptance criteria and calculations in detail. Appropriate calculations are defined in each analytical SOP.

8.3 Batch QC

Samples are batched together by matrix and analysis. Each batch of samples (20 or fewer samples of the same matrix type prepared using the same reagents, standards and procedures in the same time frame) is processed with a set of specific QC samples that are used to assess the performance of the entire measurement process (sample preparation, analysis and data reduction). Analysts are responsible for defining a batch within the constraints defined in this manual, the specific method, and programming in the LIMS. C&T's LIMS assigns a unique batch number identification to which all QC samples are linked and compliance criteria are automatically evaluated.

Each batch is required to contain a method blank to assess contamination and prevent false positive results. To assess performance with respect to precision and accuracy the batch contains a Laboratory Control Sample (LCS). Other QC required in each batch are specified by the method

SOP, and specific contractual requirements. C&T's LIMS system assigns unique QC sample identification numbers, linked to the batch identification for every QC sample processed in the batch. The correlation of QC sample results to sample results is managed through the LIMS batch identification number.

The following types of QC samples are included as part of C&T's batch QC assessment procedures. Requirements for specific types of QC samples, their frequency, evaluation criteria, acceptance limits and corrective action criteria are specified in the method procedures (SOP), and in QAPPs submitted by clients. Procedures for preparing and analyzing batch QC samples are discussed in each method SOP.

8.3.1 Laboratory Control Sample (LCS)
An LCS is a matrix-specific blank sample, (e.g. sand for soils/solids and reagent water for liquids) spiked with a representative or comprehensive selection of the target analytes. The LCS is prepared and analyzed in exactly the same manner as the samples in the batch. The LCS results demonstrate the performance of the measurement system in the absence of matrix effects. LCS results are evaluated by comparing the known sample concentrations with those calculated from the measurement system using percent recovery (%R) calculations. Acceptance criteria are established for minimum and maximum recoveries for each analytical method.

8.3.2 Matrix Spike Samples (MS)
A matrix spike is one sample in the batch to which a know concentration of representative (or comprehensive) selection of the target analytes has been added. The matrix spike results demonstrate the accuracy of the method in the matrix being analyzed.

8.3.2 Matrix Spike Sample Duplicate (MSD) or Laboratory Control Sample Duplicates (LCSD)
Matrix spike or laboratory control sample duplicates are used to evaluate both the accuracy and reproducibility (precision) of the measurement systems or test methods. Precision is evaluated by comparing the concentrations, as determined for duplicate sample analyses, using Relative Percent Difference (RPD) calculations. Acceptance criteria are established for the maximum acceptable RPD for each method. In the absence of sufficient sample to perform two matrix spike samples, two LCS's are prepared and substituted for the MS and MSD.

8.3.3 Sample Duplicates
Sample duplicates are used to evaluate the reproducibility (precision) of the method on a given matrix and to gain information on matrix effects. Precision acceptance criteria for duplicates are established based on maximum RPD values.

8.3.4 Quantitative evaluation of precision and accuracy
Precision and accuracy are evaluated by calculation of percent recovery (%R) and Relative Percent Difference (RPD).

The percent recovery of a component is the quotient of the spike result less the sample result (if any) of the component divided by the amount of spike added multiplied by 100.

$$\text{Percent Recovery} = (SSR - SR) / SA \times 100$$

Where SSR = Spiked Sample Results, SR = Sample Result and SA = Spike Added

The Relative Percent Difference (RPD) is the quotient of the first sample result less the second (duplicate) sample result divided by the mean of the results multiplied by 100.

$$RPD = | (R1 - R2) | / ((R1+R2)/2) \times 100$$

Where R1 is the result of the first analysis, and R2 is the result of the duplicate analysis.

Specific mathematical definitions of other calculated QC parameters and data reduction algorithms appear in the SOP's for each measurement method, and are comprehensively addressed in the QA Procedures SOP on calculations. Acceptance criteria are established so that the analyst can objectively and rapidly assess the quality of the data.

With as many measurements as the laboratory performs, the wide variety of matrix types that the laboratory receives, and because acceptance criteria are based on a 99 percent confidence interval, QC parameters do at times fail to meet acceptance criteria. In the event that a particular limit is exceeded, the analyst must determine if the failure invalidates the entire batch. To facilitate this assessment the Batch QC Assessment Matrix (Figure 8.2) is used to determine the disposition of the batch.

8.3.5 Method Blanks

Each batch is required to contain a method blank to assess contamination and prevent false positive results. In the event that a method blank results in a value above the method detection limit, the analyst uses the Method Blank Flowchart (Figure 8.1) to determine the impact on the sample data in the batch. As required by the Navy, if the contamination is less than the reporting limit, a note is placed on the internal case narrative; if the contamination is greater than the reporting limit, the data is qualified and discussed in the final hardcopy report.

8.4 Sample Quality Control

In many analyses there are methods of determining the performance on particular samples. For organic compound analyses, surrogate spikes, a non-target analyte added to each sample and QC sample prior to extraction or sample preparation, assist with determining the accuracy of the analysis on a particular sample. Failure to meet %R acceptance limits may result in the reanalysis of a single sample, unless obvious chromatographic interferences are present. Repeated failure indicates that the sample result may be biased, or that the sample is not amenable to analysis by the method being used. Other sample specific controls include:

- precision between repeat injections,
- internal standard response (where this calibration technique is used),
- interference check standards and samples for AA and ICP measurements,
- post-digestion spikes for AA and ICP analyses,
- method of standard addition (MSA) analyses for AA and ICP measurements.

Specific applications of these techniques are method-dependent and are described in detail in the method SOPs.

8.5 Audits and Scheduled Quality Assessments

In addition to assessing environmental data for precision and accuracy, C&T participates in several types of assessment programs.

8.5.1 Performance Evaluation Samples

Performance evaluation samples are obtained from third-party, NVLAP-certified sources and analyzed by C&T. The results are reported back to the agency or supplier who then evaluates the results against the known or true values and provides C&T with a performance report. These reports are used to determine corrective action and method development priorities and to demonstrate comparability of the data produced by C&T with results generated by other laboratories analyzing the same samples. C&T participates in at least 2 performance evaluation studies annually, for each type of regulatory program (Safe Drinking Water Act, Clean Water Act, and Resource Conservation and Recovery Act). This includes WS (Water Supply), WP (Water Pollution), UST (Underground Storage Tank) and SOIL studies that are purchased from NVLAP-accredited third party suppliers. Many clients also send performance evaluation samples to the laboratory as part of project quality requirements.

8.5.1.1 Internal Quality Control Samples

C&T employs a number of internal QC samples to assess performance of methods, instrument systems, analysts or all of these variables, as well as monitoring the routine performance of Laboratory Control Samples (LCS). The results of these events initiated by the QA Director are tabulated, evaluated and used to improve lab performance.

8.5.2 Internal Audits

The QA Director will conduct internal audits periodically. In addition to scheduled audits, random audits of specific procedures or areas are an effective means of ensuring that QA practices such as method and SOP compliance and documentation is maintained at all times. Two types of internal audits are performed annually. Quality Systems Audits are performed to evaluate the effectiveness and implementation of quality control systems established in this manual, and detailed in the SOP's. Data quality audits are performed to assess the quality and integrity of data archived by the laboratory.

8.5.2.1 Quality Systems Audits

QA Systems Audits are the type of audit most frequently performed by clients and certifying agencies. They are designed to evaluate the implementation of quality control systems within each group of the laboratory. Procedures for performing the Quality systems audits including group specific checklists have been developed and appear in QA SOP's. This type of audit is to be performed by either the Lab or the QA Director at least once annually.

8.5.2.2 Data Quality Audits

Data Quality Audits are performed once annually across all groups to thoroughly evaluate the integrity and quality of the data generated and archived by the laboratory. Data quality audits involve a full reconstruction of reported results from the lowest level of raw data archived. They are designed to demonstrate compliance to data collection, storage, and archiving procedures. Data quality audits are to be implemented for each test product routinely performed by the laboratory. Procedures for performing data quality audits including GC and GC/MS Tape audits appear in the QA SOP's.

8.5.3 External Audits

External audits are performed by state agencies, third party accreditors, clients and their contractors. C&T is dedicated to providing information to clients regarding procedures and QA practices.

8.5.4 Annual Audit Activity Summary Reports

The QA Director is responsible to prepare an annual report of all audit activities both internal and external, conducted in the laboratory. The report is designed to summarize the results of all internal and external audit activities. Summaries of findings, observations along with exceptions and disagreements are to appear in this report. The recipient of the report is the Lab Director and President.

8.6 Comparability, Representativeness and Completeness

Three less quantifiable quality criteria are comparability, representativeness, and completeness of the data generated for a particular project. With respect to comparability of data, C&T's inhouse control limits and participation in performance evaluation studies, which compare results among a number of laboratories, demonstrates that the laboratory, given the same sample as another laboratory, can generate comparable data. Representativeness and completeness have to be assessed on a project level, against regulatory holding times, field duplicates, and project-specific laboratory QC. Laboratory duplicates provide an indication of the ability of the laboratory to select representative aliquots of the samples provided, but does not provide information regarding the representativeness of the samples taken for a project with respect to the scope of the project. The percentage of data generated by the laboratory for a project that meets all analytical data quality objectives is just one measure of the overall data completeness for a project.

8.7 Method Validation & Method Detection Limit Studies

The implementation of a new analytical method requires a Method Detection Limit study, valid initial and continuing calibration, and the compliant analysis of two laboratory control standards (LCS) and at least one PE sample from an outside source. The performance of this validation study must be on file at the laboratory, associated and supporting raw data shall be filed with the validation report or obtainable in the archive lab records.

Method detection limit (MDL) studies are conducted to demonstrate the lower limits of detection for which a method including all steps for sample preparation, treatment, extraction/digestion, clean-up, and instrumental analysis procedures is capable of performing. MDL studies are performed annually and when significant changes in procedures for sample preparation, cleanup or instrumental analysis are implemented. When the lab has more than one instrumental measurement system for a given test procedure, and these systems have significant differences in responsiveness to the same analytes, the lab will establish MDL's for each instrument. C&T has established a comprehensive procedure (QA SOP's MDL Procedure) for performing & documenting MDL's including all data reduction algorithms and documentation requirements.

Figure 8.1 Method Blank Acceptance Flowchart

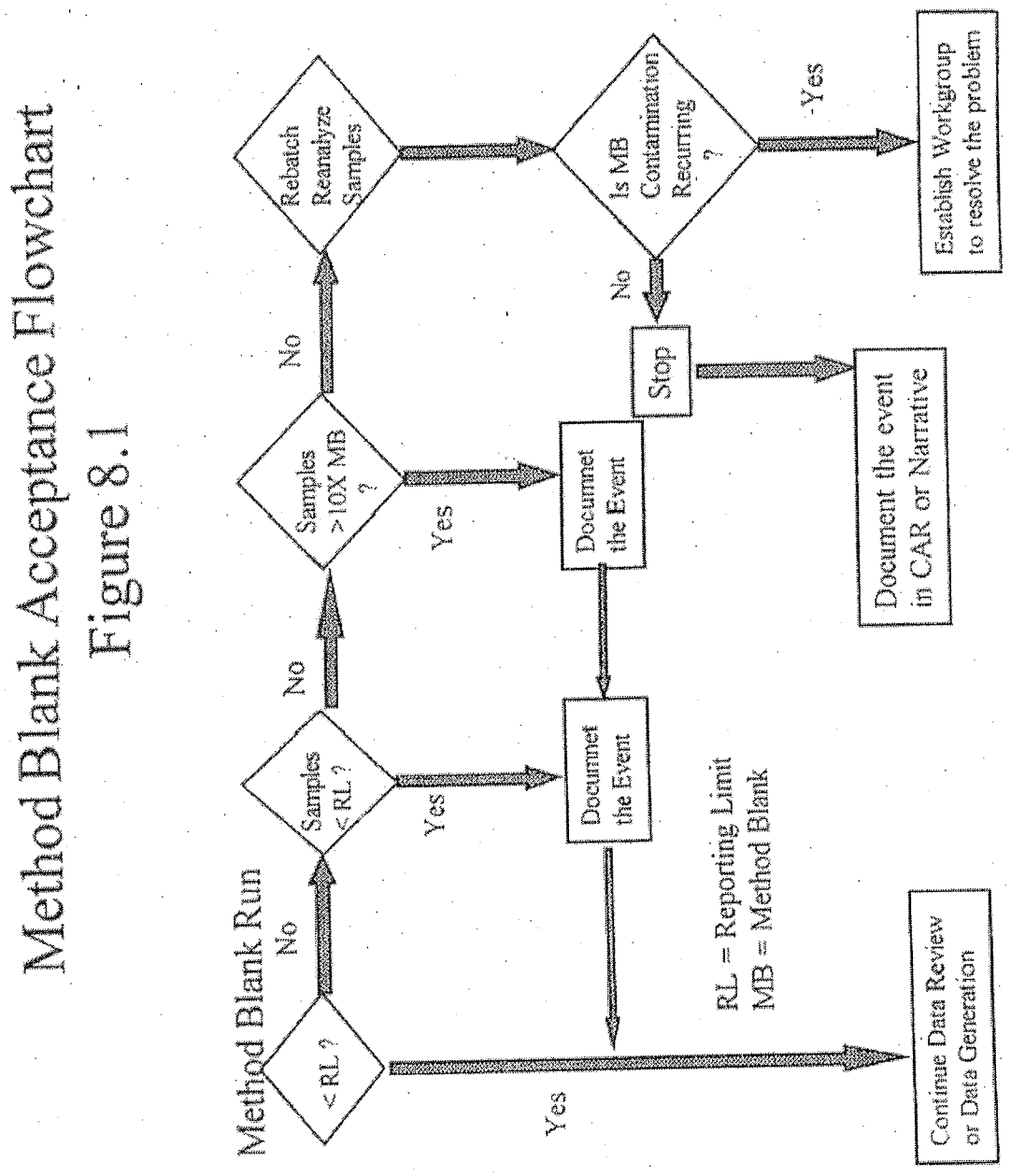


Figure 8.2 Batch QC Acceptance Matrix

BATCH QC ACCEPTANCE MATRIX

+ PASS, - FAIL

CASE	1	2	3	4	5	6	7	8
LCS %REC	+	+	+	+	-	-	-	-
MS, MSD %REC	+	-	+	-	+	-	+	-
MS, MSD %RPD	+	+	-	-	+	+	-	-

LCS %REC: The analyte concentrations in a laboratory control standard (LCS) are determined as a percentage of the known concentration of the analyte(s) in the LCS. Acceptance limits are established for the method and defined in the SOP's.

MS/MSD %REC: The Matrix Spike (MS) and Matrix Spike Duplicate (MSD) %Recovery determinations demonstrate the accuracy of the measurement system on sample matrices. The analyte concentrations in an MS and MSD are determined and compared to limits set in the SOP's for each method as a percentage of the known concentration of the analyte(s) added to the samples.

MS/MSD %RPD: The relative percent difference (RPD) of duplicate recovery measurements from the MS and MSD are determined and compared to limits set for each method as a measurement of the precision of the measurement system.

Evaluations of Batch QC Sample Measurements

Case 1: Batch QC data are acceptable.
Case 2: Batch QC Data is acceptable; matrix effect confirmed.
Cases 3 & 4: Batch QC data are unacceptable. Data are rejected, all samples in the batch must be re-extracted and reanalyzed *unless sample matrix problems are determined and documented.*
Case 5: Batch QC data are unacceptable. Data are rejected, all samples in the batch must be re-extracted and reanalyzed *unless an isolated LCS problem is determined and documented.*
Cases 6, 7 & 8: Batch rejected. Data are rejected; all samples in the batch must be re-extracted and reanalyzed.

9.0 DATA REVIEW

9.1 Peer Review Process

Second party review is a fundamental principle of quality control for analytical data. At C&T we follow this principle through the application of a peer review program. This program is supplemented by Department Manager review as a training and management tool. All analytical results, whether generated by computer systems or through manual calculations, are reviewed by a second party to prevent simple errors from being reported.

For all activities where analysts are entering data into the LIMS a second party review is required. Daily procedures such as sample digestion or extraction must be verified through the peer review of data. Infrequent or irregular procedures will also be subjected to second party review and files documenting this process must be maintained. All reviews must be documented by signing on the pre-printed "Reviewed by" line or through the use of the "Reviewed by" ink stamp that is available throughout the laboratory.

Standard data package preparation and review is completed as follows: When an analyst completes a batch of data or a client job, he/she prepares the data package according to the appropriate SOP. The analyst initiates a review checklist and verifies the contents and accuracy of the data package using the checklist as a guide; controlled copies of these checklists can be found in the Quality Assurance SOP's. The analyst then signs off on the data package and passes it to a peer for review. This review includes a 100% verification of the original analysis, again using the checklist as a guide. Both the analyst and peer reviewer must be familiar with the data package requirements for the analysis (specifics are located in the appropriate analytical SOP) and have been designated as a peer reviewer by the Group Leader or Department Manager.

It is the responsibility of the individual performing a specific activity to secure a peer review in a timely fashion. Department Managers are responsible for verifying that infrequent tasks are reviewed in a timely manner. Individuals using the data in the next step (analysis of extracts or digestates, or preparing reports) must verify that the data have been reviewed. If the review has not been done they must alert the responsible individual who must obtain review. Unreviewed data cannot be passed on to the next step in the process. An individual can request that the next person to utilize the information perform the peer review, but it is the party actually doing the work who is responsible for securing a second party review prior to the data proceeding in the system.

All data are subject to second party review within the group to prevent simple transcription or calculation errors. Both the analyst and reviewer must initial the data prior to sending it to the Client Services Group for reporting.

All analytical records, including QC data, are generated and stored as described below.

9.2 Analytical Data Review

C&T's quality program requires 100% peer review of all analytical data and up to 10% of all data must be reviewed by the QA Director or his/her designee. The analyst completing the work is responsible for securing peer review prior to passing the data to the next step in the system (usual final report and client data package preparation). The Peer review process must include the following procedures:

- Each data package must include a review checklist that is initiated by the analyst performing the analysis. The first thing the peer reviewer must check is whether or not the analyst has completed the review checklist. If this has not been done the data package is returned immediately to the analyst for completion. It is not the responsibility of the peer reviewer to finish the work of the analyst.

- The peer reviewer then completes each step in the checklist. If a calculation is verified, this is written directly on the raw data accompanied by a date and initials to demonstrate that the calculation was verified. Notes concerning the QC are recorded directly on the checklist. Any questions concerning the data are taken first to the analyst, and then to the Group Leader or Department Manager if the analyst and peer reviewer cannot reach a consensus. All decisions regarding the data should be clearly documented. All QC outliers must be clearly documented, the reason for reporting the data logically stated, and the participating parties must initial and date the records.

- Every item on the checklist must be completed prior to the peer reviewer signing off on the data package. Unanswered questions must be taken to the Department Manager or Group Leader for resolution prior to signing off on the data package. It is the responsibility of the peer reviewer to assure that the data is complete and can be reconstructed.

- When the peer reviewer is confident that the package is complete and correct, the checklist is signed and dated in the appropriate space. The data package is then passed on to the Group Leader, Department Manager, or QC Chemist for review.

9.2.1 Semivolatile and Volatile Organics

The sample preparation (extraction) associated with organic analyses utilizes method-specific bound notebooks to record all data associated with sample extraction and preparation. Alternatively, the process can be documented in LIMS and a batch report used as documentation of the extraction process. In either case a copy of the record is transferred to the appropriate analyst with the sample extracts and becomes part of the permanent record.

The Gas Chromatography (GC) and Gas Chromatography/Mass Spectrometry (GC/MS) analyses utilize either computer generated sequence files or instrument-specific bound benchbooks for injection data. Computer generated quantitation reports, chromatograms, and mass spectra are filed by analytical batch number. The analytical and QC results are reviewed by the analyst before submittal to the Department Manager, or their designee, who approves the data and transfers it to the appropriate project file where it is maintained.

9.2.2 Metals and General Chemistry

The sample preparation (digestion) associated with metals analyses utilizes a bound benchbook to record all data associated with sample digestion and preparation. A method number, designation of whether Inductively Coupled Plasma Spectroscopy (ICP), Flame Atomic Absorption (FAA) and /or Graphite Furnace Atomic Absorption (GFAA) digestion was performed is recorded by batch in the notebook. A separate benchbook is maintained for all cold vapor atomic absorption spectroscopy sample preparation. A copy of the appropriate digestion logbook is transferred with the digested samples to the analyst and after that, with the analytical data to the Department Manager for review.

Records for metals and other inorganic parameters analyzed using automated instrumentation (ICP, GFAA, Ion Chromatography, etc.) are maintained in instrument-specific benchbooks.

Computer printouts from these instruments and copies of the run logs are reviewed and initialed by the analyst prior to final review by the Department Manager or their designee. The data is then transferred to the project file where it is maintained.

All records for tests using non-automated general chemistry techniques are maintained in method specific notebooks. Copies of these notebook pages are submitted to the Department Manager for review along with the reduced, final result that is recorded on an analytical worksheet or spreadsheet.

9.3 Peer Qualifications

It is clear that in order for the peer review program to function, the reviewers must meet certain minimum requirements. Analysts new to a particular procedure are not qualified to complete the review of another analysts' work. Department Managers are responsible for determining if an individual has sufficient knowledge in a particular analysis to complete the review. It may not be necessary to be proficient in the actual analysis to be capable of performing peer review for that analysis. While the GC pesticide chemist may not be able to sit down and run the GC volatiles procedure they are sufficiently proficient in gas chromatography and the required procedure to be trained to complete the peer review.

Department Managers are responsible for determining the skills necessary for peer review of each analysis in their group. As it is the goal of the documentation to make the analytical process clear to an individual who has not actually performed the analysis, it will not be necessary for all reviewers to be proficient analysts in each procedure. Familiarity with the appropriate SOP, compendial method, and QC criteria is a requirement.

Department Managers are responsible for maintaining lists of peers for each analysis. Peers need not currently be assigned to the work group (many Project Managers can serve as peer reviewers if necessary for analyses in which they are trained) but must be familiar with the procedures and the SOP. It is the Department Manager's responsibility to provide sufficient training (and documentation of training) to have two peers available for every analysis within their group.

9.4 Department Manager Data Review, Reporting and Verification

Department Manager review is necessary to assure that the decisions made by analysts of different experience levels are acceptable. This review has two distinct parts:

- Department Managers are responsible for determining that qualified individuals have completed the review process appropriately. The Department Manager or QC Chemist must review Any QC outliers that are to be reported to assure that the logic is sound and expressed in an understandable manner. The date and Department Manager's initials must appear by each explanation to confirm that the decision is acceptable. This review must be completed by the Department Manager for all data generated by the group.

- In addition, Department Managers must perform a complete review of 10 percent of the data generated in their group. This task can be done by the Department Manager serving as the peer reviewer on at least 10 percent of the data generated in his/her group. It is the Department Manager's responsibility to maintain a balance in this level of review, making sure that they review 10 percent of the data generated by each analyst to assure that on going training is provided to all analyst. This review is documented in the same manner as regular peer review.

9.5 Data Entry

Final results and associated quality control are reported daily by analysts through the Department Manager. Any QC results falling outside acceptable limits are appropriately flagged and an explanation included on the report.

After the analysis is listed as complete for that sample set, a report is generated. At this point, the report is transferred to the appropriate Project Manager for final review.

9.6 Project Management Review

Each project is assigned to a Project Manager when the samples are received at C&T. This individual is selected based on the scope of work, familiarity with a particular client's requirements, laboratory workload, or, in some cases, upon the client's specific needs or requests.

The Project Manager is responsible for tracking the progress of the samples from the time they are logged into the laboratory, through analysis, and until the analytical data are reported to the client.

Once an analytical report is complete, the Project Manager reviews the final report against the following criteria:

- Reasonableness of Data: The data are reviewed as to whether the results reported on various analyses are internally consistent. They compare analyses such as BOD and COD, and the amount of organic contamination reported; general mineral balances; volatile organics measured by different methods; TDS and specific conductivity; and other chemical relationships. They also compare data on samples within the same project file, and if descriptive information about the samples is available, may conclude that the results are reasonable in comparison with each other or known site history. In some instances the Project Manager will ask the laboratory staff to try to discover the source of a discrepancy. If the discrepancy cannot be resolved the client is informed.

- Accuracy in transcription of names, dates, sample number, results, and consistency in labeling throughout the report.

- Acceptability of QA/QC Data: The Project Manager ensures that the QC data are within acceptance limits and that appropriate QC data are included in the final report. If a QC parameter is outside acceptance limits, the Project Manager ensures that an appropriate explanation is included in the report.

The Project Manager and the Operations Manager (or a designee) then sign the final report. Questions about final reports should be directed to the Project Manager, or to the Operations Manager.

9.7 Quality Assurance Data Review

The Quality Assurance Director is responsible for reviewing at least 10% of the data reported by each analytical department, including the final reports assembled by the Laboratory Project Managers. This review is intended to verify that all laboratory personnel routinely implement the laboratory's quality systems and that the data meets method, client, and regulatory requirements.

10.0 DATA STORAGE & DOCUMENT CONTROL

All data and reports are archived on computer tape, CD ROM or other electronic media and in hard copy form. Archival storage in all formats is limited to a period of no less than five years as required by NELAP. Data may be retained for longer periods of time, either on-site or off-site as required by the laboratory's clientele. Storage of archival data for more than 5 years requires project or contract specific written approval of the Lab Director, and in many instances advance compensation for anticipated storage and cataloging costs.

10.1 Archival Data Storage & retrieval

Archival data are typically stored at the laboratory for one year after the date they were generated, or longer, depending on space available and specific client data storage agreements. Long term archival data are cataloged, transported, and stored offsite by a records-management contractor. Archived data is maintained at C&T's cost for the use of our clients and stakeholders and they are regarded as the sole property of C&T. Data retrieval from offsite storage is considered a service provided by C&T to it's clients and as such these requests are subject to fees. C&T regards its client relationship protected by attorney client privilege. Accordingly, C&T will not release archival data to any third party without specific written authorization of the client who paid for the data. Subpoenas for records received by C&T will be submitted to the client for their sole action.

10.2 Data Security & fraud

C&T maintains controls to insure that the ethical practices are implemented at our laboratory. Effective procedures to control for the most common types of laboratory fraud rely primarily upon the individual integrity of the data generator. For this reason, we focus our training and efforts at defeating lab fraud on the individual. The following systemic control procedures have been developed to protect C&T and its clients from incidents of fraudulent data generation practices.

10.2.1 Integration Procedures: Controls for "Peak Shaving"

Peak shaving is defined as the practice of inappropriately manipulating chromatographic peak integrations by lab automation software for the purpose of making what would *obviously* be noncompliant data adhere to specifications. *Peakshaving* is usually confined to chromatographic peak integrations involving calibrations, surrogate and MS/MSD spike recovery data.

C&T conducts formal training classes to define the practice and clarify C&T policies, work rules and ethical issues involving data manipulation practices. The guidelines covered for this practice are outlined below.

Hardcopy raw data, printed for review and filing should contain, to the greatest extent practical, the integration limits and baseline information. C&T's policy is that manual reintegration of CLASS data files is a matter of professional judgment. We allow analysts to manually manipulate and reintegrate data files within defined guidelines using professional judgment. Manual integration, if performed, must follow a pattern of consistency. This guidance refers to the consistent treatment of similar data. For example, continuing calibration files should be integrated in the same fashion as initial calibrations. Surrogates and matrix spiking compounds in samples with similar matrix effects should be consistently integrated.

Any data that is manually integrated must be flagged as such by the data acquisition software. It is not permissible to alter, by deletion, the chromatogram or the data flags. It is not permissible to change the data file to the extent that it does not conform to the definition of raw data. It is not permissible to delete peaks or "alter the picture" by deletion.

Unacceptable file manipulation is defined as an obvious manipulation of the chromatographic data for the purposes of obtaining a compliant result, when that result could clearly and only be obtained by an inappropriate manipulation of the data.

The Standard Operating Procedure (SOP) for the method shall specify parameters for integration and conditions for manual modification of automatic integrator presets. The SOP shall detail the flagging conventions used by the data reduction software to indicate that a manual integration was performed. Allowable manual reintegration for the sole purpose of improving the QC compliance data, and only for this reason, is not permissible.

10.2.2 "Time Travel" Controls

Time travel is the practice of turning off a LAS or instrument control computer, resetting the date/time clock and performing an analysis at an erroneous date & time, for the purpose of meeting data quality objectives, usually holding time for samples.

The primary systemic control mechanism for time travel rests with two, and if needed three, separate timekeeping systems in the data collection process. The LIMS data collection systems are designed in a manner such that time travel cannot occur as a result of one person acting alone. The primary clock for datalogging at each C&T facility shall be the LIMS server (Sun SPARCstation) clock. LAS clocks (i.e. HP-UX, TJA-Thermospec) are secondary clocks. Tertiary clocks are instrument control and acquisition computers or devices (i.e. PC's connected to an LAS). Only those individuals authorized as database administrators will have the required security clearance sufficient to set (or reset) the LIMS Server system clock. For valid data to be entered on the system at an incorrect time, both the LIMS clock and the data acquisition or LAS clock must be reset to within plus or minus 30 minutes of the same time. For this to occur, the User/Data generator and the DBA must operate together, simultaneously & in a conspiratorial manner.

10.3 Distribution and Document Control Procedures

C&T has a system of controls for documents to insure that current documents are in use, and that superseded documents are filed in appropriate records. The following documents are relevant to the Quality Assurance Program, and procedures for dealing with them are appropriately addressed here:

- QA Program Manual
- Standard Operating Procedures

Standard Operating Procedures are in place for the procedures for updating these documents.

10.3.1 QA Program Manual

The QA Program Manual shall be reviewed and revised at annual intervals. The President is responsible to see the task is completed, the QA Director is responsible for implementing the procedures for distribution of current versions, and replacing and archiving obsolete versions. The following addresses specific procedures applicable to the QA Program manual.

10.3.1.1 Controlled versions of the QA Manual
One controlled version of the QA Manual will be issued. All copies of the QA Manual made from the original are specified as uncontrolled. If a client requests a controlled copy for a legitimate reason, an original controlled copy will be printed, signed by QA Director, Operations Manager, and Lab Director and distributed by the QA Director. The QA Director shall maintain a log of those receiving controlled copies.

10.3.1.2 Revision/ replacement
When a QA Manual is superseded with a new revision, the original controlled copy is placed in archives. All copies of the outdated version, except the archived original, are to be destroyed when the new version is released. Each employee is required to read each new revision of the laboratory Quality Assurance Manual and to sign a statement of understanding. The original is maintained in the Quality Assurance files and a copy of the statement is placed in the individual's personnel files.

10.3.1.3 Expiration
C&T QA Manuals expire one year after the revision date. Therefore all copies of C&T QA Manuals that have revision dates more than one year old are outdated and are to be destroyed by those who possess them.

10.3.1.4 Revision frequency
The QA Program Manual shall be revised annually. The President and the QA Director shall be responsible for preparing modifying, production and approval of the manual each year.

10.3.1.5 Distribution
Distribution of the current version of the QA Manual is the responsibility of the QA Director. The QA Director is also responsible for collecting and destroying all copies in the lab, as well as archiving the original controlled copy.

10.3.2 Standard Operating Procedures (SOPs)
SOPs are developed, revised, reviewed, approved, distributed and controlled according to the requirements specified by the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (Ch.5, Section 5.10) and the Department of Defense Quality Systems Manual for Environmental Laboratories (DoD QSM), as outlined below. The QA Director is responsible for implementing the SOP document control and revision procedures.

10.3.2.1 Format
The format for SOP's is specified in the NELAP Quality Systems Standard, Section 5.10 and each SOP for analytical methods generally contains the following elements:

- Title and Signature Page: Contains the title of the document, the appropriate revision number, the date the document became effective, a unique identification (consisting of the volume and section numbers), revision number, approval signatures, and signatures of qualified analysts. Typically, SOP's are reviewed by the individual responsible for implementing the procedure, and approved the responsible individual's supervisor and the Quality Assurance Director (or their designees).

- Header Information: A header must appear on each page of the SOP and must contain the following information in this order:

SOP Volume:	the book where the printed SOP's are stored
Section Number:	assigned using the C&T SOP Table of Contents
Page Number:	(e.g., 1 of 4, etc.)
Revision Number:	whole numbers, beginning with 0 for new SOP's
Effective Date:	date the revision supercedes the previous version
Filename:	describes where that particular SOP resides in the laboratory's electronic network

- Scope: Briefly (one or two sentences) describe the purpose of the SOP. For analytical SOPs it is appropriate to include applicable matrices and reporting limits.
- References: Cite the compendial methods used in generating the SOP.
- Sample preservation & regulatory holding time.
- Modifications: List deviations from the reference method.
- Safety: List any special safety requirements or concerns that may be encountered in the performance of the procedure.
- QC Requirements: List the QC requirements of the method (e.g. method blank, LCS, matrix spike, calibration, etc.) and applicable corrective actions.
- Interferences: A brief discussion of potential sources of high or low bias.
- Procedure: The steps required to perform the analysis, including calibration, sample preparation (may be included by reference to a separate SOP), typical instrument settings & conditions, reagents, standards, and example equations used to calculate sample and batch QC results.
- Pollution Prevention & Waste Disposal.

10.3.2.2 Review, approval, and implementation

If the document is an SOP for use within Client Services or the analytical departments, the SOP must be approved, signed, and dated by the Department Manager and the QA Director (or designees in their absence). The SOP must include the date that the revised procedure supercedes the outdated version.

If the document is an SOP is for the QA Program, the SOP may be generated without a title page and may be signed by the Laboratory Director or the QA Director.

10.3.2.3 Document control

Controlled copies of an SOP reside in the labeled volume with the QA Director and in the appropriate Workstation Notebooks. When superseded by a revision, one controlled copy of the outdated SOP will be archived by the QA Director; all other copies are to be destroyed. To control copies and prevent the use of an outdated SOP's, only the signed originals are considered "current" and may not be removed from the Workstation Notebooks except by the QA Director. It is the responsibility of each Department Manager to replace or destroy any uncontrolled or outdated photocopies that may be in use within their respective groups.

10.3.2.4. Electronic storage and revision control
All SOP's are stored in MS-Word2000 format at a designated address in the data system. The SOP's stored in these files are security password protected. The QA Director and the Lab Director are the only persons authorized to possess the password, and to modify these files. SOP's in electronic format can be accessed at any appropriately configured workstation in "read only" mode.

10.3.2.5 Schedule for revision
SOP's for analytical procedures in general use are to be reviewed every 12 months. SOP's for critical QC procedures, (QC Limits, Method Detection Limits, Data and Peer Review) are to be updated annually. All other SOP's will be updated as needed, with the objective of updating annually. The President and the QA Director are responsible for ensuring the revision process is implemented.

11.0 CORRECTIVE ACTION PROCESS

An effective Quality Assurance program requires rapid, effective and thorough identification and correction of issues and errors that affect data quality. Timely and effective action minimizes the possibility of producing data of unknown or insufficient quality. The Laboratory Director and the QA Director, with the concurrence of the Department Managers, direct the corrective action when problems that affect product or service quality are identified.

Once a situation has been identified as producing marginal or non-compliant data, the cause of the problem must be identified. Corrective action requires defined responsibilities for scheduling, performing, documenting, and demonstrating the effectiveness of the action. It is the responsibility of the appropriate Department Manager to work with the QA Director to develop a plausible corrective action plan. The plan is tested, if possible, to determine whether the action results in the production of compliant data by eliminating the problem. If the out of control event cannot be resolved samples will be reanalyzed, if possible, with acceptable quality assurance results.

The overall goal of the corrective action process is to identify and permanently correct situations that lead to generation of errors in the measurement process. The documentation component of this process is implemented to record the samples affected by the situation, and as a managerial tool to facilitate correcting the errors in a timely manner.

A Corrective Action Report is used to document corrective action plans and activities. Any member of the C&T staff may initiate corrective action, but the plan itself must involve the QA Director and should involve any affected Department Managers.

Data are not generated in a situation where questions concerning the data quality may exist unless the client has been informed of the situation and has dictated that course of action. The QA Director has the authority and responsibility to require any activities that could compromise or have compromised data quality objectives to be discontinued or limited until corrective action is complete and quality is no longer compromised.

11.1 Corrective Actions for Sample Analyses & Related Activities

For all organic and most inorganic analyses, the LIMS automatically identifies surrogate, spike, and calibration failures. Corrective action must be initiated when blank spike recoveries or %RPD, calibration response factors, sample loss, or other method-specific QC procedures or criteria cannot be met by the analysis. For matrix spikes or duplicates, the LIMS system FAIL notifications and case narratives may serve as corrective action notices.

11.2 Corrective Action Report

If corrective actions can be completed within 48 hours without impacting data quality, a notice need not be initiated, otherwise a Corrective Action Report (CAR) must be initiated within 4 hours of detecting the out of control event. Corrective action reports must be initiated by the analyst, or by the reviewer who identifies the mistake; these reports are then automatically emailed from the LIMS to the Department Manager, Project Manager, QA Director, and Operations Manager. The corrective action notices are serially numbered and available through the LIMS and a copy is filed in the job jacket of the order(s) affected.

11.3 When Sample Analyses Cannot Meet Acceptance Criteria

If corrective action cannot resolve an out of control sample analysis, and results of sample analysis are affected, the Department Manager must notify the Quality Assurance Director. If in the QA Director's judgment, results of sample analysis are affected, a summary of out of control QA procedures must be communicated to the client with the results of the affected analyses. The process outlined below for correcting systems must be initiated.

In many instances, methods and procedures designed for a wide variety of sample matrices do not and/or cannot be completed to meet acceptance criteria. Typical examples of these conditions are matrix effects that prevent the achievement of surrogate recoveries, and matrix spiking accuracy and/or precision criteria. Data reported from testing activities that do not meet acceptance criteria must be flagged, annotated or otherwise qualified to the client receiving the data. Every effort must be made to clearly identify the reason the acceptance criteria could not be met and to report efforts made by C&T to achieve compliant results. Case narratives and flags or footnotes on certificates of analyses are acceptable means of informing clients of analyses that could not be performed to meet established performance criteria.

11.4 Corrective Action for Systemic Errors

C&T has developed and implemented a process to identify and correct recurring errors, and those that arise from system design or implementation processes. It is the QA Director's responsibility to manage and document the process.

1. Identify the problem, and conditions leading to the problem, as briefly and clearly as possible.
2. Identify a responsible person, or team of people, who can be held accountable for the outcome of the corrective action. Select an individual(s) who is responsible and able by authority or ability to achieve the results desired.
3. With the input, feedback and general agreement of the responsible individual or task force, the QA Director will develop a written outline of what lab processes are affected and what actions needs to be taken.
4. Identify all steps which must be taken immediately and proceed with alacrity.
5. Set corrective action goals in writing, with the following criteria addressed:
   Responsible Party: One person who will be responsible for completing the task or realizing the goal
   Timetable: A date when the action will be completed
   Completed Specifications: What a corrected situation looks like.
   Priority: Where does this goal/task fit in with other tasks and responsibilities addressed by the responsible party?

11.5 Filing & Tracking Corrective Actions

The laboratory has established an electronic system for record keeping and documenting the efforts and results of the system of corrective action outlined above. Copies of the completed corrective action forms will be included in the project file for the associated samples and are available through the LIMS.

11.6 Auditing Corrective Actions

The President/ Lab Director will periodically audit corrective action files and efforts. Corrective actions are subject to progress/completion checks during internal audits.

12.0 QUALITY ASSURANCE REPORTING & RECORDS

The QA Director maintains sufficient records to furnish evidence of the day-to-day activities affecting quality in accordance with the requirements of the C&T QA Plan. Based on the results of internal and external audits, the C&T QA Director prepares reports as needed for the Department Managers, Operations Manager, and the Lab Director. Typical QA reports contain:

- Deficiencies and problems identified throughout the period or audit, action items, and results of monitoring efforts.
- Procedural problems that have affected quality results.
- Past due corrective actions, if relevant or applicable.
- Objectives from any previous reports that were not achieved.
- QA/QC objectives for the period.

All QA program records and data files are maintained in a secure manner, insuring that only authorized personnel have access to them. Records are periodically archived in secure third party offsite storage according to procedures that maintain access control, and retrieval.

12.1 Reports to Lab Director

Any major problem that is not easily resolved at the Department Manager level is brought to the attention of the appropriate laboratory management staff for resolution. Any time problems occur on a frequent basis, reports to laboratory management are made weekly or daily, as needed, until the situation is resolved.

12.2 QA Director's Planning and Review Reports

Goal setting and reviews of priorities for personnel responsible for development and implementation of the QA program are important quality management tools. The QA Director is responsible for preparing periodic reports detailing shorter and longer-term goals for the QAP at C&T. These reports are expected to summarize the periodic reports outlined above, report on monitoring results of corrective action plans, and identify and propose solutions to any recurring problems.

12.3 Lab Directors Performance Reviews of QA Director

The Lab Director is expected to produce periodic reports covering the design, development, and implementation of C&T's QAP. The performance reviews of the QA Director and the QAP, particularly the items that relate to the effectiveness of efforts taken by the QA Director to meet his or her responsibilities, is an important component of the QAP at C&T.

These reports can be useful to identify the financial or managerial freedom or limitations and constraints placed on QA Directors in their efforts to implement the QAP. This report is also a review of effectiveness from the individuals with ultimate authority and is a testament, if nothing else, to their involvement with and commitment to the quality improvement process.

12.4 QA Recordkeeping

Documenting the efforts undertaken by C&T staff toward implementing the QAP is a significant undertaking, requiring skills in filing and document retrieval. The QA Director is responsible for filing

documentation supporting the activities related to the QAP. Filing systems for the following reports, documents, events and activities are the responsibility of the QA Director.

- Corrective Actions
- Method validation files
- MDL Studies
- Control Charts and Control Limit determinations
- Standard Operating procedures
- Benchbooks, Run Logs, Instrument Logs and other bound notebooks
- Training files and participation records
- Audits results and follow-up
- Certification applications and approvals

APPENDIX_1: Containers, Preservation & Holding Times

(Client Services SOP 3.1, Rv.4, Effective 12/03/04)

ORGANICS	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[7]
TPH/Diesel [3]	Water	EPA 3520	EPA 8015B	14/40 [6]	500 mL	1L G	None
	Soil	CA LUFT[4]	EPA 8015B	14/40 [6]	50 g		
TPH/Gasoline [2]	Water	EPA 5030	EPA 8015B	14 days	40 mL	2 x 40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8015B	14 days	5 g		
Alcohols (Methanol, Ethanol)	Water	Direct Inject	EPA 8015B	14 days	40 mL	2x40mL VOA	None
Aromatic VOCs (8020 list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
BTXE [1]	Water	EPA 5030	EPA 8021B	14 days	40 mL	2 x 40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8021B	14 days	5 g		
Carbon Dioxide (dissolved)	Water	METHOD[4]	RSK-175	14 days	40 mL	2x40mL VOA	None
Creosote, coal tar	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
1,4-Dioxane	Water	EPA 3520	EPA 8270-SIM	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270-SIM	14/40 [6]	30 g		
Dioxins & Furans	Water	METHOD[4]	EPA 8280	30/45 [6]	1 L	1L G	None[8]
	Soil	METHOD[4]	EPA 8280	30/45 [6]	10 g		
Dioxins & Furans (Low Concentration)	Water	METHOD[4]	EPA 8290	30/45 [6]	1 L	1L G	None[8]
	Soil	METHOD[4]	EPA 8290	30/45 [6]	10 g		
Dissolved Gasses (except CO_2)	Water	METHOD[4]	RSK-175	14 days	40 mL	2x40mL VOA	HCL
Dissolved Gasses (CO_2)	Water	METHOD[4]	RSK-175	14 days	40 mL	2x40mL VOA	None
Gasoline Oxygenates	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
Halogenated VOCs (8010 list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
MTBE (Methyl tert-Butyl Ether)	Water	EPA 5030	EPA 8021B	14 days	40 mL	2x40mL VOA	HCL[8]
			EPA 8260B	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8021B	14 days	5 g		
			EPA 8260B	14 days	5 g		
Nitroaromatics & Nitramines (Explosives)	Water	METHOD[4]	EPA 8330	7/40 [6]	1 L	1L G	None[8]
	Soil	METHOD[4]	EPA 8330	14/40 [6]	10 g		
Organochlorine Herbicides	Water	METHOD[4]	EPA 8151	7/40 [6]	1 L	1L G	None
	Soil	METHOD[4]	EPA 8151	14/40 [6]	30 g		
Organochlorine Pesticides	Water	EPA 3520	EPA 8081A	7/40 [6]	1 L	1L G	None
	Soil	EPA 3550	EPA 8081A	14/40 [6]	30 g		
Pentachlorophenol	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
Phenols (including cresols)	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]

Curtis & Tompkins, Ltd.

ORGANICS	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[7]
Phthalates	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
Polychlorinated Biphenyls (PCBs)	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
	Water	EPA 3520	EPA 8082	7/40 [6]	1 L	1L G	None
Polynuclear Aromatic Hydrocarbons	Soil	EPA 3550	EPA 8082	14/40 [6]	30 g		
	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
			EPA 8310	7/40 [6]	1 L	1L G	None[8]
			EPA 8270-SIM	7/40 [6]	1 L	1L G	None[8]
Polynuclear Aromatic Hydrocarbons	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
			EPA 8310	14/40 [6]	30 g		
			EPA 8270-SIM	14/40 [6]	30 g		
Semivolatile Organics	Water	EPA 3520	EPA 8270	7/40 [6]	1 L	1L G	None[8]
	Soil	EPA 3550	EPA 8270	14/40 [6]	30 g		
Volatile Organics (8240 list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		
Volatile Organics (extended list)	Water	EPA 5030	EPA 8260	14 days	40 mL	2x40mL VOA	HCL[8]
	Soil	EPA 5030[9]	EPA 8260	14 days	5 g		

LEGEND:
VOA: amber VOA vial

G: amber glass
P: Polyethylene

ORGANIC COMPOUNDS - NOTES:

1.) Benzene, toluene, ethylbenzene, and xylenes: MTBE (methyl tert-butyl ether) may be added upon request.

2.) Total Petroleum Hydrocarbons as Gasoline: JP-4, mineral spirits, or stoddard solvent may be added upon request. Reporting limits may be higher for fuels other than gasoline.

3.) Total Petroleum Hydrocarbons as Diesel: motor oil, commercial jet fuel, JP-5, hydraulic oil, transformer oil, or Bunker C may be added upon request. Reporting limits may be higher for fuels other than diesel.

4.) CA LUFT: California Department of Health Services Leaking Underground Fuel Tank Manual, October 1989. "Method" indicates that the prep method is an integral part of the analytical method.

5.) Holding times specified in 40CFR 136.3 Table 2 (Clean Water Act/ NPDES) and SW-846 Table 2-36 Revision 3, December 1996.

6.) X/Y: X days from sample collection to extraction, then Y days from extraction to analysis.

7.) Samples should be kept at 4^0C from time of collection until analysis. Preserved containers can be supplied by C&T. HCL: hydrochloric acid to pH < 2, H_2SO_4: sulfuric acid to pH < 2, NaOH: sodium hydroxide to pH > 12

8.) Free chlorine should be neutralized with 0.008% $Na_2S_2O_3$.

9.) Prep method EPA 5035, using Encore sampling devices, may be used in place of EPA 5030; contact lab for details.

METALS	Matrix	Prep Method	Analytical Method	Holding Time[5]	Minimum Volume	Water Sampling Container	Water Sampling Preservative[3]
Cations	Water	EPA 3010A	EPA 200.7 or 6010B	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6010B	6 mo	2 g		
ICP Metals	Water	EPA 3010A	EPA 200.7 or 6010B	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6010B	6 mo	2 g		
ICP-MS Metals	Water	EPA 200.8	EPA 6020	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6020	6 mo	2 g		
Hexavalent Chromium	Water	METHOD[1]	EPA 7196A	24 hr	100 mL	500 mL P	None
		METHOD[1]	EPA 7199	24 hr	50 mL	250 mL P	None
	Soil	METHOD[1]	EPA 7196A	30 days	40 g		
Lead	Water	EPA 3010A	EPA 200.7 or 6010B	6 mo	100 mL	250mL P	HNO_3
		EPA 200.8	EPA 6020	6 mo	100 mL	250mL P	HNO_3
	Soil	EPA 3050B	EPA 6010B	6 mo	2 g		
		EPA 3050B	EPA 6020	6 mo	2 g		
Lead in High Volume Air Filters	Air	METHOD[1]	EPA 7420	NS	Varies		
Mercury	Water	METHOD[1]	EPA 7470A	28 days	100 mL	250mL P	HNO_3
	Soil	METHOD[1]	EPA 7471A	28 days	0.5 g		
Organic Lead	Water	CA LUFT[1]	CA LUFT[1]	14 days	100 mL	500mL P	None
	Soil	CA LUFT[1]	CA LUFT[1]	14 days	50 g		
Priority Pollutant Metals	Water	EPA 3010A/ Method[1]	EPA 6010B/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
		EPA 200.8/ Method[1]	EPA 6020/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
	Soil	EPA 3050B/ Method[1]	EPA 6010B/7400	6 mo/28d[4]	5 g		
		EPA 3050B/ Method[1]	EPA 6020/7400	6 mo/28d[4]	5 g		
RCRA (8) Metals	Water	EPA 3010A/ Method[1]	EPA 6010/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
	Soil	EPA 3050B/ Method[1]		6 mo/28d[4]	5 g		
CA Title 26 Metals (CAM 17)	Water	EPA 3010A/ Method[1]	EPA 6010B/ 7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
		EPA 200.8/ Method[1]	EPA 6020/7400	6 mo/28d[4]	100 mL	500mL P	HNO_3
	Soil	EPA 3050B/ Method[1]	EPA 6010B/ 7400	6 mo/28d[4]	5 g		
		EPA 3050B/ Method[1]	EPA 6020/7400	6 mo/28d[4]	5 g		
Tributyl Tin ("Organo-tin")	Water	EPA 3520C	GC/FPD	NS	1 L		
	Soil	EPA 3550B	GC/FPD	NS	10 g	1L P or G	None

LEGEND:
G: amber glass
P: Polyethylene

METALS - NOTES:

1.) "Method" indicates that the prep method is an integral part of the analytical method.
CA LUFT: California Department of Health Services Leaking Underground Fuel Tank Manual, October 1989

2.) Holding times specified in 40CFR 136.3 Table 2 (Clean Water Act/ NPDES) and SW-846 Table 2-36 Revision 3, Dec 1996.

3.) Samples should be kept at 4°C from time of collection until analysis. Preserved containers can be supplied by C&T.
HCL: hydrochloric acid to pH < 2, H_2SO_4: sulfuric acid to pH < 2, NaOH: sodium hydroxide to pH > 12,
HNO_3: nitric acid to pH < 2

4.) 28 day holding time for mercury; 6 month holding time for all other elements.

General Chemistry	Method	Holding Time[8] Water	Holding Time[8] Soil	Minimum Volume Water	Minimum Volume Soil	Water Sampling Container	Water Sampling Preservative[9]
Acidity	EPA 305.1	14 days	--	100 mL	--	250mL P	None
Acid Value	AOCS Cd 3a-63	NS[5]	NS[5]	20 g	20 g	50mL G	None
Alkalinity (as $CaCO_3$)	EPA 310.1	14 days	NS[5]	100 mL	--	250mL P	None
Ammonia Nitrogen	EPA 350.3	28 days	--	100 mL	--	250mL P	H_2SO_4
Asbestos	various	NS[5]	NS[5]	1 L	50 g	1L P	None
Bicarbonate Alkalinity	EPA 310.1	14 days	--	100 mL	--	250mL P	None
Bioassay, %survival	NPDES	36 hr	--	5 gallons	--	5gal cube	None
Bioassay, screen	CCR Title 22	36 hr	36 hr	500 mL	200 g	1L G	None
Biochemical Oxygen Demand (BOD)	EPA 405.1	48 hr	--	600 mL	--	1L P	None
BTU (Heating Value)	ASTM D-240	NS[5]	NS[5]	5 g	5 g	50mL G	None
Carbon, Total Organic	EPA 415.2	28 days	28 days	40 mL	25 g	2 x 40mL VOA	H_2SO_4
Carbon, Total Inorganic	EPA 415.2	28 days	--	40 mL	--	2 x 40mL VOA	H_2SO_4
Carbonate Alkalinity	EPA 310.1	NS[5]	--	100 mL	--	250mL P	None
Cation Exchange Capacity	EPA 9081	--	6 mo	--	10 g	--	--
Chemical Oxygen Demand (COD)	EPA 410.4 / SM 5220D	28 days	--	100 mL	--	250mL P	H_2SO_4
COD, Filtered	EPA 410.4	28 days	--	100 mL	--	250mL P	H_2SO_4
Chloride	EPA 300.0	28 days	--	100 mL	--	250mL P	None
Chlorine, Residual	EPA 330.5	in field	--	100 mL	--	250mL G	Foil wrapped
Coliform, Fecal		6 hr	--	100 mL	--	sterile 100mL	$Na_2S_2O_3$
Color	AOCS methods	48 hr	--	50 mL	--	250mL G	None
Conductivity	EPA 120.1	28 days	--	100 mL	--	250mL P	None
Corrosivity to Steel (NACE)	EPA 1110	NS[5]	NS[5]	1 L	1000 g	1L G	None
Chromium, Hexavalent	EPA 7196A	24 hrs	30 days	100 mL	40 g	500mL P	None
Chromium, Hexavalent	EPA 7199	24 hrs	--	50 mL	--	250mL P	None
Cyanide	EPA 335.2 or 9010B/9014	14 days	14 days	500 mL	5 g	500mL P	NaOH
Cyanide, Amenable	EPA 9010B/ 9014	14 days	14 days	500 mL	10 g	500mL P	NaOH
Cyanide, Reactive	SW846 Ch.7	NS[5]	NS[5]	25 mL	10 g	500mL P	None
Density	ASTM or AOCS	NS[5]	--	200 mL	--	250mL P or G	None
Dissolved Oxygen	EPA 360.1	in field	--	100 mL	--	250mL G	None
Dissolved Sulfide	EPA 376.2	7 days	--	50 mL	--	500mL P	NaOH
Ferrous Iron (Fe2+)	SM 3500FeD	in field	--	50 mL	--	100mL P or G	HCL
Ferric Iron (Fe3+)	SM 3500FeD	24 hr	--	see Notes	--	2 x 100mL P	see Notes (6)
Flash Point	EPA 1010	NS[5]	--	60 mL	NA	250mL P	None
Fluoride	EPA 300.0 or 340.2	28 days	28 days	100 mL	10 g	250mL P	None
Free Fatty Acids	AOCS methods	NS[5]	NS[5]	50 mL	50 g	100mL P or G	None
Free Liquids (Paint Filter Test)	EPA 9095	NS[5]	NS[5]	100 mL	50 g	500mL wide	None
Halogens, Total Organic	EPA 9020	28 days	28 days	200 mL	10 g	250mL P or G	H_2SO_4
Hardness, as $CaCO_3$	EPA 130.2	6 mo.	--	100 mL	--	250mL P	HNO_3
Heating Value	ASTM D-240	NS[5]	NS[5]	5 g	5 g	100mL P or G	None
Hexavalent Chromium	EPA 7196A	24 hr	30 days	100 mL	40 g	500mL P	None
Hexavalent Chromium	EPA 7199	24 hrs	--	50 mL	--	250mL P	None

General Chemistry	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative[9]
Ignitability	SW846 Ch.7	--	NS[5]	--	10 g	--	None
Iodine Value	AOCS Cd 1b-87	NS[5]	NS[5]	10 g	10 g	50mL G	None
Iron, Ferrous (Fe2+)	SM 3500FeD	24 hr	--	50 mL	--	100mL P	HCL
Iron, Ferric (Fe3+)	SM 3500FeD	24 hr	--	see Notes	--	2 x 100mL P	see Notes (6)
Moisture	CLP-SOW	--	NS[5]	--	25 g	--	None
Nitrate Nitrogen	EPA 300.0	48 hr	--	100 mL	--	250mL P	None
Nitrite Nitrogen	EPA 300.0	48 hr	--	100 mL	--	250mL P	None
Nitrate/ Nitrite Nitrogen	EPA 300.0	28 days	--	100 mL	--	250mL P	None
Nitrogen, Ammonia	EPA 350.3	28 days	28 days	100 mL	10 g	250mL P	H_2SO_4
Nitrogen, Total Kjeldahl (TKN)	EPA 351.4	28 days	28 days	50 mL	5 g	1L P	H_2SO_4
Oil & Grease, Petroleum (H.E.M.-SG)	EPA 1664A	28 days	--	1 L	--	1L G	HCL
Oil & Grease, Total (H.E.M.)	EPA 1664A	28 days	--	1 L	--	1L G	HCL
Organic Lead	CA LUFT[7]	14 days	14 days	100 mL	50 g	250mL P	None
Oxygen Demand, Biochemical	EPA 405.1	48 hr	--	600 mL	--	1L P	None
Oxygen Demand, Chemical	EPA 410.4 / SM 5220D	28 days	--	100 mL	--	250mL P	H_2SO_4
Oxygen, Dissolved	EPA 360.1	In field	--	100 mL	--	250mL G	None
Paint Filter Test	EPA 9095	NS[5]	NS[5]	100 mL	50 g	500mL wide	None
Perchlorate	EPA 314.0	28 days	--	100 mL	--	250mL P	None
Peroxide Value	AOCS Ja 8-87	NS[5]	NS[5]	5 g	5 g	50mL G	None
PH	EPA 9040B/9045C	24 hr	14 days	100 mL	50 g	250mL P	None
Phenolic Compounds	EPA 420.1	28 days	--	500 mL	--	1L G	H_2SO_4
Phosphate, ortho-	EPA 300.0 or 365.2	48 hr	--	50 mL	--	100mL P	None
Phosphate, Total	EPA 365.2	28 days	28 days	50 mL	10 g	250mL P	H_2SO_4
Reactive Cyanide	SW846 Ch.7	NS[5]	NS[5]	25 mL	10 g	500mL P	None
Reactive Sulfide	SW846 Ch.7	NS[5]	NS[5]	25 mL	10 g	500mL P	None
Residual Chlorine	EPA 330.5	In field	--	50 mL	--	100mL G	None
Resistivity	EPA 120.1	28 days	--	100 mL	--	250mL P	None
Salinity	SM 2520B	NS[5]	--	250 mL	--	250mL G	wax seal
Saponification Value	AOCS Cd 3d-25	NS[5]	NS[5]	5 g	5 g	50mL G	None
Silica	EPA 370.1	28 days	28 days	50 mL	10 g	100mL P	None
Solids, Settleable	EPA 160.5	48 hr	--	1 L	--	1L G	None
Solids, Total Dissolved	EPA 160.1	7 days	--	100 mL	--	250mL G	None
Solids, Total Suspended	EPA 160.2	7 days	--	100 mL	--	250mL G	None
Solids, Total Volatile	SM 2540	7 days	NS[5]	100 mL	50 g	250mL P	None
Specific Gravity	ASTM or AOCS	NS[5]	--	200 mL	--	250mL P or G	None
Sulfate	EPA 300.0	28 days	--	100 mL	--	250mL P	None
Sulfide	EPA 376.2	7 days	--	50 mL	--	500mL P	NaOH + ZnAc
Sulfide, Dissolved	EPA 376.2	7 days	--	50 mL	--	500mL P	NaOH
Sulfide, Reactive	SW846 Ch.7	NS[5]	NS[5]	25 mL	10 g	500mL P	None
Sulfite	EPA 377.1	< 24 hr	--	100 mL	--	500mL P	None
Surfactants	EPA 425.1	48 hr	--	250 mL	--	1L P	None
Sulfur	ASTM methods	6 mo	6 mo	1 g	1 g	50mL G	None
Tannins & Lignins	SM 5550B	NS[5]	--	50 mL	--	100mL P or G	None
Thiosulfate	Chevron Chemical	NS[5]	--	100 mL	--	250mL P	None

General Chemistry	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative[9]
Total Dissolved Solids (TDS)	EPA 160.1	7 days	--	100 mL	--	250mL P	None
Total Fatty Acids	AOCS methods	NS[5]	--	50 mL	50 g	100mL P or G	None
Total Inorganic Carbon	EPA 415.2	28 days	28 days	40 mL	25 g	2 x 40mL VOA	H_2SO_4
Total Organic Carbon (TOC)	EPA 415.2	28 days	--	40 mL	--	2 x 40mL VOA	H_2SO_4
	Walkley-Black	--	28 days	--	25 g	--	None
Total Organic Halogens	EPA 9020B	28 days	28 days	200 mL	10 g	250mL P or G	H_2SO_4
Total Suspended Solids (TSS)	EPA 160.2	7 days	--	100 mL	--	250mL G	None
Total Volatile Solids	SM 2540	7 days	NS[5]	100 mL	50 g	250mL P	None
Tributyl Tin	GC/FPD	NS[5]	NS[5]	1 L	10 g	1L P or G	None
Turbidity	EPA 180.1	48 hr	--	100 mL	--	250mL G	None
Viscosity	ASTM methods	NS[5]	--	25 mL	--	50mL P	None

General Minerals	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative[9]
Alkalinity (as $CaCO_3$)	EPA 310.1	14 days	NS[5]	100 mL	--	250mL P	None
Chloride, Sulfate	EPA 300.0	28 days	--	100 mL	--	250mL P	None
Conductivity	EPA 120.1	28 days	--	100 mL	--	250mL P	None
PH	EPA 9040B/ 9045C	24 hr	14 days	100 mL	--	250mL P	None
Total Dissolved Solids (TDS)	EPA 160.1	7 days	--	100 mL	--	250mL P	None
Ca, Fe, Mg, Na, Zn, Hardness	EPA 200.7 or 6010B	6 mo	6 mo	100 mL	--	250mL P	HNO_3
Optional Analysis (can be added to list):							
Surfactants (MBAS)	EPA 425.1	48 hr	--	250 mL	--	1L P	None

RCI	Method	Holding Time[8]		Minimum Volume		Water Sampling	
Reactivity, Corrosivity & Ignitability		Water	Soil	Water	Soil	Container	Preservative[9]
Reactive Cyanide	SW846 Ch.7	NS[5]	NS[5]	25 mL	10 g	500mL P	None
Reactive Sulfide	SW846 Ch.7	NS[5]	NS[5]	25 mL	10 g	500mL P	None
PH	EPA 9040B/ 9045C	24 hr	14 days	100 mL	50 g	250mL P	None
Ignitability	SW846 Ch.7	--	NS[5]	--	10 g	--	None

Major Cations	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative[9]
Ca, Mg, K, Na	EPA 200.7 or 6010B	6 mo	6 mo	100 mL	--	250mL P	HNO_3

Major Anions	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative
Bicarbonate & Carbonate (Alkalinity)	EPA 310.1	14 days	NS[5]	100 mL	--	250mL P	None
Chloride, Sulfate	EPA 300.0	28 days	--	100 mL	--	250mL P	None

Major Anions	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative

Ion Chromatography	Method	Holding Time[8]		Minimum Volume		Water Sampling	
		Water	Soil	Water	Soil	Container	Preservative[9]
Bromide	EPA 300.0	28 days	NS[5]	100 mL	1 g	250mL P	None
Chloride	EPA 300.0	28 days	NS[5]	100 mL	1 g	250mL P	None
Nitrate-Nitrogen	EPA 300.0	48 hr	NS[5]	100 mL	1 g	250mL P	None
Nitrite-Nitrogen	EPA 300.0	48 hr	NS[5]	100 mL	1 g	250mL P	None
Ortho-Phophate Phosphorous	EPA 300.0	48 hr	NS[5]	50 mL	1 g	250mL P	None
Sulfate	EPA 300.0	28 days	NS[5]	100 mL	1 g	250mL P	None
Hexavalent Chromium	EPA 7199	24 hrs	N/A	50 mL	--	250mL P	None
Perchlorate	EPA 314.0	28 days	N/A	100 mL	--	250mL P	None

NOTES:

5.) NS: No holding time is specified in the regulations for these methods.

6.) Ferric Iron (Fe^{3+}) is the difference between total and ferrous iron.
Requires submission of two polyethylene bottles, one preserved with HCl and one with HNO_3.

7.) CA LUFT: California Department of Health Services Leaking Underground Fuel Tank Manual, October 1989.

8.) Holding times specified in 40CFR 136.3 Table 2 (Clean Water Act/ NPDES) and SW-846 Table 2-36 Rev 3, Dec 1996.

9.) Samples should be kept at 4^0C from time of collection until analysis. Preserved containers can be supplied by C&T.
HCL: hydrochloric acid to pH<2, H_2SO_4: sulfuric acid to pH<2, NaOH: sodium hydroxide to pH > 12, ZnAc: Zinc Acetate.

LEGEND:

mg/L: milligrams per liter
µg/L: micrograms per liter
mg/Kg: milligrams per kilogram
µg/Kg: micrograms per kilogram
VOA: amber VOA vial
G: Glass
P: Polyethylene

Curtis & Tompkins, Ltd.

APPENDIX_2: C&T Standard Operating Procedures

SOP Volume: Volatile Organics
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VOLATILE ORGANICS: STANDARD OPERATING PROCEDURES

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SEMIVOLATILE ORGANICS: STANDARD OPERATING PROCEDURES

SOP Volume: Organic Extractions
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EXTRACTION LAB: STANDARD OPERATING PROCEDURES

SECTION 1: General Extraction Lab Procedures

SECTION 2: Liquid Sample Extractions

SECTION 3: Solid Sample Extractions

SECTION 4: Waste Dilutions and Screening Methods		File Name	Rev#	Effective or Re-Approved
4.1	PCB's in Oil	PCB_OIL	4	10-May-02
4.2	Organochlorine Pesticide Waste	8081_WASTE	3	18-Jun-02
4.3	Medium level extraction for wastes for 8270	EPA3580.EXT	*update in progress*	
4.4	T.E.H by Waste Dilution of Solvents & Waste Oil	TEH_WASTE	1	30-Apr-02

SECTION 5: Sample Cleanup Methods		File Name	Rev#	Effective or Re-Approved
5.1	General Cleanup Notes - Method 3600	SW-846		
5.2	Alumina Column Cleanup - Method 3610	SW-846		
5.3	Alumina Cleanup of Petroleum Waste - Method 3611	SW-846		
5.4	Florisil Column Cleanup - Method 3620	SW-846		
5.5	Silica Gel Column Cleanup - Method 3630	SW-846		
5.6	Automated GPC Cleanup - Method 3640	SW-846		
5.8	GPC Using ABC Model AS2000	GPC_AS2000	5	03-Jul-01
5.9	Florisil Cleanup of Hexane Extracts	EPA3620	2	05-Mar-04
5.10	Sulfur Cleanup - Method 3660	EPA3660	3	15-Dec-01
5.11	Silica Gel Clean-up of TEH Extracts	TEHSG	4	15-Jun-01

SECTION 6: CLP Extraction Methods
Note: All CLP methods have been archived since 1995.

SECTION 7: SPECIAL PROJECTS		File Name	Rev#	Effective or Re-Approved
7.4	PCB Soxhlet Extraction of Wood Chips	PCBSOX.EXT	1	11-Aug-96
7.6	PCB Manchester Extraction	PCB-Manchester	3	03-May-02
7.7	8270-SIM	8270_SIM	0	08-Feb-02
7.8	Organo-Phosphorous Pesticides (OPP) in Water	OPP_W	0	19-Mar-02
7.9	Fitration of Water Samples for TEH	TEH_Filtration	0	*in progress*

SECTION 8: WIPES		File Name	Rev#	Effective Date
8.1	PCBs in Wipe Samples	PCB_WIPE	5	17-May-02
8.3	8081 Organochorine Pesticides in Wipes	8081_WIPE	0	*in progress*
8.4	8270 Semivolatiles in Waste & Oil Samples	8270_WASTE	3	03-Oct-02
8.5	8270 Semivolatiles in Wipe Samples	8270WIPE.EXT	2	11-Aug-96

METALS: STANDARD OPERATING PROCEDURES

	Filename	Rev	Effective or Re-Approved
SECTION 6: GRAPHITE FURNACE AA METHODS			
All GFAA Methods have been archived since 1998			
SECTION 7: FLAME AA METHODS	Filename	Rev	Effective or Re-Approved
7.1 Analysis of Digests & Waters for Lead by FAA	PB_FAA 1	25-JUN-97	
7.2 Determination of Lead in Hi Volume air Filters	PBFLTSOP	0	ARCHIVED
SECTION 8: ORGANOMETALLIC COMPOUNDS			
8.1 Analysis of Organometallics in Oil Samples	DILT&SHT	0	ARCHIVED
8.2 Analysis of Organic Lead in Soil & Water	ORG_PB	2	16 April 04
SECTION 9:	Filename	Rev	Effective or Re-Approved
SECTION 10: MISCELLANEOUS			
10.2 Instrument Detection Limit SOP	IDL	Draft	25-JUN-97

SOP Volume: Wet Chemistry
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WET CHEMISTRY: STANDARD OPERATING PROCEDURES

4.11	Surfactants (MBAS), EPA 425.1/ 5540C	MBAS	4	06-JUL-2001
4.12.1	Total Organic Carbon (TOC) by EPA 415.2	TOC_415	*update in progress*	
4.12.2	Total Organic Carbon (TOC) by EPA 9060	TOC_9060	*update in progress*	

SECTION 5: MISCELLANEOUS		Filename	Rev	Effective or Re-approved
5.1	Flash Point, EPA 1010	FLASH	5	16-JUL-2002
5.2	Hardness by Calculation, 6010B/2340B	HARDCALC	3	09-JUL-2002
5.3	Ignitability of Solids, ASTM D-93/ EPA 1010	IGNITE	2	15-JUN-1998
5.4	Reactivity, Sulfide & Cyanide, SW846 Ch.7	REACTIVTY	4	09-JUL-2003
5.5	Temperature, EPA 170.1	TEMP	1	15-JUL-1996

SECTION 6: ION CHROMATOGRAPHY		Filename	Rev	Effective or Re-approved
6.1	Anions by EPA 300.0	ANIONS_300	6	08-MAY-2003
6.2	Perchlorate by EPA 314	CLO4	1	12-MAY-2003
6.3	Hexavalent Chromium by EPA 7199	CR6_IC	0	07-MAY-2002

CLIENT SERVICES: STANDARD OPERATING PROCEDURES

QUALITY ASSURANCE: STANDARD OPERATING PROCEDURES

SECTION 4: Specifications and Corrective Actions	Filename	Rev	Effective or Re-Approved
4.1 Control Limits & Trend Analysis	Control Limits	7	09-FEB-2004
4.2 Corrective Action Procedure	CAR_rv4	*update in progress*	
4.2.1 PE Sample Corrective Actions	CORGUIDE.WPD	2	21-FEB-2002
4.3 Method Development	Method Development	3	10-MAY-2004
4.4 Method Detection Limits	MDL Study	6	20-FEB-2004

SECTION 5: Documentation Procedures	Filename	Rev	Effective or Re-Approved
5.1 Data package organization, submittal storage	DATAPAK	3	04-AUG-2004
5.3 Generating and Updating SOP's	SOP_SOP	5	04-AUG-2004
5.4 Lab Benchbooks, Content & Filing	BENCHBOOK	3	01-SEP-2004
5.5 Electronic Data Storage & Retrieval	ELECTDTA	*moved to Section 9.5*	
5.6.1 QC Data Review by Peer, DM, QC Chemist	DATA REVIEW	4	04-AUG-2004
5.6.2 Procedure & Checklists for QA Data Review	QA_REVIEW	0	04-AUG-2004
5.7 Records Custody for Change of Ownership	Records_Co_Sale	0	04-AUG-2004
5.8 Updating the Laboratory QA Manual	QAM_Updates	0	04-AUG-2004

SECTION 6: Staff Training and Development	Filename	Rev.	Effective or Re-Approved
6.1 Commonly used Calculations	EQUATIONS	2	04-AUG-2004
6.2 Workstation Training Analyst Proficiency	TRAIN	3	04-AUG-2004
6.3 Training Checklists			
6.3.1 Training Checklist – Organics	ORGANICS.xls	3	04-AUG-2004
6.3.2 Training Checklist – Metals	METALS.xls	3	04-AUG-2004
6.3.3 Training Checklist – Wet Chem	WETCHEM.XLS	3	04-AUG-2004
6.4 Job Descriptions			
6.4.1 Analyst	an_desc	3	05-JAN-2004
6.4.2 Project Manager	proj_mgr	2	07-JAN-2004
6.4.3.1 Group Leader	gl_desc	4	05-JAN-2004
6.4.3.2 Deptarment Manager	deptmgr_desc	4	05-JAN-2004
6.4.4 Quality Assurance Director	qad_desc	1	30-SEP-2003
6.4.5 Operations Manager	ops_mgr	0	30-SEP-2003
6.4.6 Support Technician	suppt_desc	2	04-AUG-2004
6.4.7 Lab Diector	lab_dir	2	30-SEP-2003
6.4.8 QC Chemist	qc_chemist	2	23-AUG-2004
6.5 Performance Appraisals			
6.5.1.1 Analyst Self Assessment	AN_SELF	2	01-OCT-2004
6.5.1.2 Analyst Performance Appraisal	AN_PERFORMANCE	3	01-OCT-2004
6.5.1.3 Analyst Peer Assessment	AN_PEER	2	01-OCT-2004
6.5.2.1 Project Manager Self Assessment	PM_SELF	2	01-OCT-2004
6.5.2.2 Project Manager Performance	PM_PERFORMANCE	2	01-OCT-2004
6.5.2.3 Project Manager Peer Assessment	PM_PEER	2	01-OCT-2004
6.5.3.1 Group Leader Self Assessment	GL_SELF	2	27-JUL-2004
6.5.3.2 Group Leader Performance Appraisal	GL_PERFORMANCE	3	09-JAN-2004
6.5.3.3 Department Mgr Performance	DM_PERFORMANCE	3	05-JAN-2004
6.5.6.1 Support Technician Self Assessment	SUPPT_SELF	0	04-AUG-2004
6.5.6.2 Support Technician Performance	SUPPT_PERFORMANCE	0	05-JAN-2004
6.5.7.2 Extraction Chemist Performance	XLAB_PERFORMANCE	0	07-JAN-2004
6.5.8.2 QC Chemist Performance	QCCHEM_PERFORM	0	01-OCT-2004

SECTION 7: Miscellaneous Procedures	Filename	Rev.	Effective or Re-Approved
7.1 Dishwashing Procedures	DISHWASH	3	01-AUG-2000
7.2 Inorganic Dishwashing	DISH_INORGANICS	5	27-OCT-2003
7.3 Dilution and Documentation and DF Conventions	DILUTNS	1	01-AUG-2000
7.5 Reprocessing Chromatographic Data Files	REPROCES	1	16-APR-2002
7.6 Purchasing Consumables	CONSUMABLES	0	25-JUL-2002

SECTION 8: References,			
8.1 40 CFR Contents	40CFR	0	13-FEB-2004
8.1 Glossary	DOD QSM App.B	2	29-JUN-2000
8.3 Superfund Glossary	NUS Corporation		1986

SECTION 9: Database Systems	Filename	Rev.	Effective or Re-Approved
9.1 LIMS Data Security	LIMS Data Security	4	10-JAN-2003
9.2 LIMS Software Development	LIMS Development	4	19-DEC-2003
9.3 LIMS Software Maintenance	LIMS Maintenance	3	19-DEC-2003
9.4 Instrument Data Processing	Instrument Data	0	28-JUN-2002
9.5 Archiving & Retreival	Archiving	0	21-Oct-2002
9.6 Insuring Compliant Manual Integration	Integration	5	13-FEB-2004

APPENDIX_3: MAJOR EQUIPMENT LIST

Curtis & Tompkins, Ltd.
November 12, 2004

Semivolatile Organics	Total #	Instrument Model & Serial #	Autosampler Model & Serial #	Detector Model & Serial #	In Service	C&T ID
GC-FID	4	HP 5890A S/N 3115A34675	HP 7673, S/N 3120A28026		<Feb.95	GC-11
		HP 5890A, S/N 3140A38570	HP 7673, S/N 3237A32122		<Feb.95	GC-13
		HP 5890E, S/N 3336A56636	HP 7673, S/N 3114A25627		<Feb.95	GC-15
		HP 5890A, S/N 3033A30233	HP 7673, S/N 3207A29781		Feb.02	GC-17
GC w/ Dual FID	1	HP 5890E, S/N 3336A51743	HP 7673, S/N 3120A28387		Dec.01	GC-20
GC w/ Headspace TCD/FID	1	Agilent 6890N, CN10414063	Gerstel CTC, S/N 124567		Oct.04	GC-24
GC w/ Dual ECD	6	HP 5890A, S/N 2843A20040	HP 7673A, S/N 2704A09401	HP 19233, S/N F1745 HP 19233, S/N L3548	Oct.90	GC-06
		HP 5890E, S/N 3336A56635	HP 7673, S/N 3442A40499	HP G1223A, S/N K0437 HP G1223A, S/N F4849	Apr.92	GC-14
		HP 5890A, S/N 3235A43989	HP 7673, S/N 3442A40503	HP G1223A, S/N F4791 HP G1223A, S/N F4833	Jun.97	GC-16
		Varian CP-2800, S/N 08829	Varian CP-8400, S/N 01089	ECD S/N A13414 ECD S/N A13413	Jul.02	GC-21
		Varian CP-3800, S/N 10300	Varian CP-8400, S/N 01820	V 02-001972-00/A13872 V 02-001972-00/A13873	Jun.03	GC-22
		Varian CP-3800, S/N 11251	Varian CP-8400, S/N 01703	V 02-001972-00/A14313 V 02-001972-00/A14314	Jun.04	GC-23
HPLC/ UV-VIS & Fluorescence	3	HP 1090, S/N 3016A02811		HP 1046A, S/N 3137G02120	Apr.94	HPLC-01
		HP 1090, S/N 2822A02025		HP 1046A, S/N 3137G02448	Feb.99	HPLC-02
		HP 1090, S/N 3332A04247		integrated into 1090	Sep.03	HPLC-03
SVOC - GCMS	6	HP 5890, S/N 3140A38163	HP 7673, S/N 3114A25622	HP 5971, S/N 3118A02337	Feb.89	BNA01
		HP 5890, S/N 3121A35677	HP 7673, S/N 3120A26239	HP 5971, S/N 3188A02950	Aug.91	BNA02
		HP 6890, S/N US00011320	HP 7673, S/N 3120A28395	HP 6890, S/N US80110918	Jun.97	BNA03
		HP 5890, S/N 3336A56592	HP 7673, S/N 3441A36905	HP 5972, A/N 3435A01840	Jul.00	BNA04
		HP 6890N, S/N US10233076	HP 7683, S/N CN23226594	HP 5973N, S/N US21843716	Oct.02	BNA[illegible]
		HP 6890N, S/N CN10335028	HP 7683, S/N CN33332145	HP 5973, S/N US33246067	Nov.03	BNA[illegible]
Accelerated Solvent Extractor	1	Dionex ASE-200, 03070482			Oct.03	ASE[illegible]
GPC	2	OI AP1000, S/N 123 10593			Jan.97	GPC[illegible]
		J2 AccuPrep, 04E-1109-3.1	S/N 4418A2317		Jul.04	GPC04

Volatile Organics	Total #	Instrument Model & Serial #	Autosampler Model & Serial #	Detector Model & Serial #	In Service	C&T ID
FID/ dual PID GC	5	HP 5890A, S/N 3336A54137	Tekmar SolaTek-72, US02218011 Tekmar 3011, US02221018		Oct.88	GC-04
		HP 5890A, S/N 2607A07244	EST Archon 8100, S/N 13972 EST Encon, S/N 278061303P/E		May-90	GC-05
		HP 5890A, S/N 2938A24861	OI Archon 4552, S/N 13245 OI 4560, S/N M951460698		Sep.91	GC-07
		HP 5890A, S/N 3336A56667	Dynatech/Dynatrap, S/N 12339-394		Jan.01	GC-18
		HP 5890A, S/N 3133A37270	Dynatech/Dynatrap, S/N 11562-794		May 98	GC-19
VOC - GCMS	9	HP 5890, S/N 2750A16308	Dynatech/Dynatrap, S/N 1159-593	HP 5972A, S/N 3501A02581	Apr.91	VOA-02
		HP 5890, S/N 2950A27368	Dynatech/Dynatrap, S/N 11474-494	HP 5970, S/N 2824A11265	Aug.92	VOA-03
		HP 5890, S/N 3235A46191	EST Archon 8100, S/N 14025 Encon P&T, S/N 314100803P	HP 5972, S/N 3251A00061	Dec.94	VOA-04
		HP 6890, S/N US00001296	Dynatech/Dynatrap, S/N 11420-294	HP 6890, S/N 00001296	Aug.96	VOA-05
		HP 5890, S/N 2950A27174	Tekmar SolaTek, US01228004 Tekmar 3011, S/N US01248008	HP 5972, S/N 3341A01178	Feb.99	VOA-06
		HP 6890, S/N US00034530	Dynatech/Dynatrap, S/N 11228-793	HP 5973, S/N 94260135	Jun.00	VOA-07
		HP 6890, S/N US00006731	Tekmar AquaTek-70, S/N 190M0421 Tekmar 3100, S/N 01039005	HP 5972, S/N 3251A00069	Mar.01	VOA-08
		HP 5890, S/N 3235A58416	Tekmar AquaTek-70, S/N 02064001 Tekmar 3100, S/N 02056029	HP5972, S/N 3341A01348	Jun.02	VOA-09
		HP 5890E, S/N 3336A9270	Tekmar AquaTek-70, US02214002 Tekmar 3100, US02247016	HP5972A, S/N 3501A02458	Nov.02	VOA-10
VOC Screener w/ Dual FID		HP 6890, S/N US00030201	HP 7683, S/N US02914395 HP 7683, S/N US91506551	HP FID, no serial number HP FID, no serial number	May.01	Screener

Metals	Total #	Instrument Model & Serial #	Autosampler Model & Serial #	Detector Model & Serial #	In Service	C&T ID
Cold Vapor/ Flame AA	1	TJA 4000, S/N 8306			Jun.92	MET-02
CVAA Mercury Analyzer	2	CETAC M6000A, A/N 039920A5X			Mar.00	MET-03
		LeemanHydra AA 112-0064-1/2003			Mar.02	MET-04
Vertical ICP Spectrometer	1	TJA 61, S/N 91882			Oct.88	MET-01
Trace ICP Spectrometer	1	TJA 61E/Trace, S/N 327490	TJA AS-300, S/N D2398		Aug.95	MET-07
Radial/Axial ICP Spectrometer	1	PE 4300DV, 077N4022801			Oct.04	MET-08
ICP-MS	1	Agilent 4500, Model G3152A S/N JP93200208			May.01	MET-05

General Chemistry	Total #	Instrument Model & Serial #	Autosampler Model & Serial #	Detector Model & Serial #	In Service	C&T ID
UV-Vis Spectrophotometer	2	HP 8452A, S/N 2610A01005			<Aug.92	UV
		Spectronics 21, S/N 3110239018				SPEC21
Conductivity Meter	2	Corning M-90, S/N B12443			Mar.97	EC
		Fisher "Traceable", S/N B12443			Feb.02	EC2
Dissolved Oxygen Meter	1	Orion 290A, S/N 004653			Mar.97	DO
Ion Chromatograph	3	Dionex DX-120, S/N 98040436	Dionex AS-40, S/N 98040181	AD 25, S/N 01060374	Jan.00	IC01
		Dionex DX-320, S/N 01070420	Dionex AS-50, S/N 01060456	AD 25, S/N 00121073	Nov.01	IC02
		Dionex DX-120, S/N 03020263	Dionex AS-40, S/N 03030608	DS4-1, S/N 03010789	Apr.03	IC03
Ion Selective Electrode	1	Orion 940, S/N R064A			Nov.97	ISE
Organic Carbon Analyzer	1	Tekmar Phoenix 8000 US03085005			Apr.03	TOC2
pH Meter	1	Orion 420A, S/N 039116			Sep.00	Orion-420
Turbidimeter	1	HF Scientific DRT-100B, S/N 22483			Mar.97	TB
Midi-Distillation System	1	Andrews 110-10-R, S/N AIZ0301			Sep.01	Midi

Data Systems	Total #	
GC/MS and Chromatography	8	HP/ Chemserver
SVOC Chemserver Data System	1	HP/ Unix
Chromatography	16	PE-Nelson/ Turbochrome
	1	HP/ Chemstation
	1	Dionex/ Peaknet
Laboratory IMS	32	C&T Sun/ Oracle
PC-LAN network	32	Novell/ Windows NT - Yossarian

Note: List does not include support equipment (thermometers, digestion blocks, balances, etc.)

APPENDIX_4: C&T Laboratory Personnel

Name/ Title	Organics/ Metals Sample Prep	Organic Analysis by GC	Organic Analysis by GCMS	Organic Analysis by HPLC	Inorganic Analyses by IC	Inorganic Analysis by AA/ AE	General Chemical Analyses	Sample Management	Project Management	Laboratory Management	LIMS/Data Management	QA/ QC Training	Degreed (BS or BA)	Advanced Degree	Years Experience (Sep.03)
Bruce Godfrey - Lab Director/President	x	x	x	x	x				x	x	x	x	x	x	25
John Goyette - Operations Manager	x							x	x	x	x	x	x		17
Teresa Morrison - QA Director	x	x	x	x	x		x	x	x	x	x	x	x		17
Dennis Dougherty - Inorganics Manager	x				x	x	x			x		x	x		20
Robert Hopeman - GC/HPLC Manager	x	x		x	x		x	x		x	x	x	x		12
Steve Stanley - Client Services Mgr	x	x				x	x	x	x	x	x	x	x		20
Terry Walsh - GC/MS Manager	x		x							x	x	x	x		13
Chris Katayanagi - Information Mgmt	x	x	x	x						x	x	x	x		13
David McNerney - Information Mgmt			x								x	x	x		11
Mary Hart - QC Chemist	x	x						x	x			x	x	x	15
Anne Kathain - QC Chemist		x	x									x	x		5
Carol Wortham - QC Chemist	x	x	x				x	x	x	x		x	x		14
Tracy Babjar - Project Manager	x	x				x	x	x	x			x	x		11
Lisa Brooker - Project Manager	x	x	x						x			x			5
Patricia Flynn - Project Manager								x	x			x	x		9
Anna Pajarillo - Projet Manager	x	x		x				x	x	x		x	x		11
Troy Windsor - Sample Control	x	x						x		x		x			12
Peter Petricka - Sample Control								x				x	x		1
Aaron Greiner - Shipping/ Bottle Prep								x				x			1
Adam Abatzis - Chemist		x	x									x	x		3
Zia Ahmad - Chemist	x											x	x		6
Fisseha Alemayehu - Chemist	x	x					x					x	x		3
Matt Bacinskas - Chemist	x	x					x					x	x		2
Brook Buswell - Chemist	x											x	x		1
Kristen Carlyon - Chemist	x	x	x			x	x	x	x	x		x	x		11
Michelle Curtis - Chemist	x											x	x		0
Stefan D'Angona - Chemist	x	x		x	x					x		x	x		4
Jennifer Dell - Chemist	x											x	x		1
Kevin Gaines - Analyst	x						x					x			0
Liza Hernandez - Chemist	x	x	x									x	x		11
Sharon Karagozlu - Chemist	x											x	x		1
Stephen Koster - Chemist	x			x						x		x	x		5
Clarence Lee - Chemist	x	x	x	x	x							x	x		6
Rodelio Manuel - Chemist	x						x					x	x		1
Junn Masongsong - Chemist	x	x										x	x		1
Dennis McCanna - Chemist	x	x			x		x			x		x	x		37
Edward McCaskey - Chemist	x		x	x						x		x	x		21
Jessie O'Brien Mee - Chemist	x											x	x		0
Blair Okuma - Chemist	x	x	x		x					x		x	x		5

Name/ Title	Organics/ Metals Sample Prep	Organic Analysis by GC	Organic Analysis by GCMS	Organic Analysis by HPLC	Inorganic Analyses by IC	Inorganic Analysis by AA/ AE	General Chemical Analyses	Sample Management	Project Management	Laboratory Management	LIMS/Data Management	QA/ QC Training	Degreed (BS or BA)	Advanced Degree	Years Experience (Sep.03)
Vania Ouzounova - Chemist		x					x					x	x		16
Parwinder Pal Singh - Chemist						x	x					x	x	x	7
Adam Pereira - Analyst	x	x										x			3
Micaela Perpetuo - Chemist	x	x								x		x	x		3
Jason Poulton - Chemist	x	x			x		x					x			4
Gabriel Prindle - Chemist	x	x										x	x		7
Joan Protasio - Chemist		x										x	x		0
Kevin Riley - Chemist	x											x			2
Jason Scott - Analyst	x	x										x			3
Radia Shiffa - Chemist							x					x	x		5
Amy Silverberg - Chemist	x	x	X									x	x		1
Micah Smith - Chemist	x	x		x	x		x					x	x		4
Jason Spence - Chemist							x					x	x		0
Morris Tran - Chemist	x	x					x	x				x	x		11
Brian Van Deren - Chemist			x									x	x		4
Thelma Vergara - Analyst	x	x										x			5
Victor Vergara - Technician	x											x			6
Donnel Ward - Chemist	x	x					x			X		x	x		3
Coral Weese - Chemist	x											x	x		1
Lara Wheeling - Chemist	x	x	x									x	x		10
Mei Wu - Chemist	x					x	x					x	x		20

EPA 6010B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	Aluminum	80 - 121	20	77 - 133	20
	Antimony	78 - 120	20	68 - 127	20
	Arsenic	74 - 132	22	63 - 151	35
	Barium	80 - 120	20	79 - 120	20
	Beryllium	80 - 120	20	80 - 120	20
	Cadmium	80 - 120	20	76 - 123	20
	Calcium	80 - 120	20	65 - 131	20
	Chromium	80 - 120	20	79 - 120	20
	Cobalt	80 - 120	20	80 - 120	20
	Copper	80 - 120	20	80 - 120	20
	Iron	80 - 120	20	66 - 122	20
	Lead	66 - 138	25	49 - 155	34
	Magnesium	80 - 120	20	73 - 124	20
	Manganese	80 - 120	20	71 - 124	20
	Molybdenum	80 - 120	20	73 - 120	20
	Nickel	80 - 120	20	74 - 120	20
	Potassium	80 - 120	20	70 - 128	23
	Selenium	58 - 142	31	44 - 156	42
	Silver	80 - 120	20	72 - 124	20
	Sodium	80 - 120	20	80 - 125	20
	Thallium	57 - 144	30	34 - 158	47
	Vanadium	80 - 120	20	80 - 120	20
	Zinc	80 - 120	20	79 - 123	20
	Boron	79 - 120	20	67 - 131	21
	Phosphorus	80 - 120	20	70 - 130	30
	Silicon	80 - 120	20	70 - 130	30
	Sulfide	80 - 120	20	70 - 130	30
	Tin	80 - 120	20	79 - 121	20
	Strontium	80 - 120	20	80 - 120	20
	Titanium	80 - 120	20	80 - 120	20
Soil	Aluminum	80 - 120	20	69 - 141	21
	Antimony	80 - 120	20	22 - 120	22
	Arsenic	80 - 120	20	68 - 120	20
	Barium	80 - 120	20	52 - 140	20
	Beryllium	80 - 120	20	76 - 120	20
	Cadmium	80 - 120	20	68 - 120	20
	Calcium	80 - 120	20	42 - 151	20
	Chromium	80 - 120	20	61 - 120	20
	Cobalt	80 - 120	20	59 - 120	20
	Copper	80 - 120	20	47 - 149	20
	Iron	80 - 120	20	64 - 145	20
	Lead	80 - 120	20	55 - 128	24
	Magnesium	80 - 120	20	51 - 151	20
	Manganese	80 - 120	20	64 - 137	20
	Molybdenum	80 - 120	20	67 - 120	20
	Nickel	80 - 120	20	43 - 139	20
	Potassium	80 - 120	20	40 - 153	21

EPA 6010B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
	Selenium	80 - 120	20	49 - 121	24
	Silver	80 - 120	20	76 - 120	20
	Sodium	80 - 120	20	73 - 126	20
	Thallium	80 - 120	20	62 - 120	20
	Vanadium	80 - 120	20	48 - 139	20
	Zinc	80 - 120	20	41 - 146	20
	Boron	77 - 120	20	51 - 131	23
	Phosphorus	80 - 120	20	70 - 130	30
	Silicon	80 - 120	20	70 - 130	30
	Sulfide	80 - 120	35	65 - 135	35
	Strontium	80 - 120	35	65 - 135	35
	Tin	80 - 120	20	64 - 128	27
	Titanium	80 - 120	20	26 - 167	20

C&T internal list numbers: 56362, 56364

EPA 7470A QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	Mercury	80 - 120	20	80 - 120	20
Soil	Mercury	80 - 120	20	64 - 139	20

C&T internal list numbers: 56370, 56372

EPA 8015B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	Gasoline C6-C10	80 - 122	20	80 - 120	20
	Gasoline C6-C12	80 - 120	20	80 - 120	20
	Gasoline C7-C12	80 - 120	20	80 - 120	20
	Trifluorotoluene (FID)	63 - 141		63 - 141	
	Bromofluorobenzene (FID)	79 - 139		79 - 139	
Soil	Gasoline C7-C12	80 - 120	20	43 - 120	27
	Gasoline C6-C10	80 - 120	20	44 - 120	28
	Gasoline C6-C12	80 - 120	20	41 - 120	28
	Trifluorotoluene (FID)	60 - 138		60 - 138	
	Bromofluorobenzene (FID)	66 - 148		66 - 148	

C&T internal list numbers: 56334, 56336

EPA 8015B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	Diesel C10-C20	45 - 137	39	49 - 131	55
	Diesel C10-C22	50 - 133	40	49 - 130	47
	Diesel C10-C24	50 - 133	40	42 - 127	45
	Diesel C10-C28	49 - 135	42	49 - 133	40
	Diesel C12-C28	44 - 141	40	71 - 128	50
	Diesel C12-C36	48 - 135	42	65 - 149	52
	Diesel C12-C32	49 - 143	38	63 - 142	34
	Diesel C12-C24	51 - 137	40	53 - 136	42
	Diesel C12-C22	51 - 137	40	54 - 135	46
	Diesel C10-C40	53 - 129	42	43 - 139	52
	Hexacosane	55 - 143		55 - 143	
Soil	Diesel C10-C20	55 - 134	20	26 - 150	47
	Diesel C10-C22	52 - 136	20	16 - 166	48
	Diesel C10-C24	52 - 137	20	11 - 169	49
	Diesel C10-C28	52 - 137	20	15 - 173	49
	Diesel C12-C28	47 - 139	20	16 - 179	52
	Diesel C12-C36	51 - 132	20	1 - 252	30
	Diesel C12-C32	61 - 131	20	32 - 154	40
	Diesel C12-C24	53 - 137	20	11 - 175	50
	Diesel C12-C22	52 - 136	20	19 - 167	48
	Hexacosane	51 - 136		51 - 136	

C&T internal list numbers: 56340, 56341

EPA 8081A QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	gamma-BHC	61 - 140	27	52 - 144	37
	Heptachlor	53 - 143	28	53 - 138	38
	Aldrin	60 - 120	25	45 - 120	35
	Dieldrin	57 - 127	25	55 - 133	35
	Endrin	59 - 136	25	60 - 130	35
	4,4'-DDT	55 - 149	31	42 - 144	41
	alpha-BHC	68 - 133	26	46 - 146	36
	beta-BHC	64 - 150	35	29 - 189	45
	delta-BHC	59 - 155	30	51 - 156	40
	Heptachlor epoxide	61 - 125	26	62 - 142	36
	gamma-Chlordane	62 - 120	24	57 - 134	34
	alpha-Chlordane	64 - 120	24	56 - 133	34
	Endosulfan I	62 - 121	23	57 - 137	33
	4,4'-DDE	66 - 121	25	49 - 128	35
	Endosulfan II	55 - 137	26	56 - 144	36
	Endosulfan sulfate	58 - 126	25	67 - 138	35
	4,4'-DDD	63 - 137	25	53 - 147	35
	Endrin aldehyde	47 - 171	37	60 - 155	47
	Methoxychlor	62 - 168	34	57 - 152	44
	Endrin ketone	58 - 134	29	62 - 144	39
Water Surrogates	TCMX	44 - 120		44 - 120	
	Decachlorobiphenyl	50 - 128		50 - 128	
Soil	gamma-BHC	42 - 120	20	41 - 120	37
	Heptachlor	49 - 126	20	48 - 130	43
	Aldrin	52 - 120	20	42 - 126	36
	Dieldrin	40 - 125	20	43 - 128	38
	Endrin	38 - 135	20	45 - 137	39
	4,4'-DDT	43 - 135	20	31 - 151	47
	alpha-BHC	41 - 120	20	40 - 120	37
	beta-BHC	41 - 120	20	47 - 128	37
	delta-BHC	27 - 126	20	29 - 127	38
	Heptachlor epoxide	43 - 120	20	46 - 131	40
	gamma-Chlordane	48 - 120	20	47 - 123	35
	alpha-Chlordane	49 - 120	20	45 - 124	36
	Endosulfan I	39 - 124	20	43 - 126	42
	4,4'-DDE	51 - 120	20	40 - 128	45
	Endosulfan II	17 - 132	20	28 - 130	43
	Endosulfan sulfate	1 - 135	20	16 - 134	50
	4,4'-DDD	46 - 126	20	46 - 128	41
	Endrin aldehyde	1 - 120	20	4 - 120	65
	Endrin ketone	14 - 134	20	20 - 134	45
	Methoxychlor	27 - 177	20	32 - 169	45
Soil Surrogates	TCMX	43 - 130		43 - 130	
	Decachlorobiphenyl	43 - 143		43 - 143	

EPA 8081A QC Limits
C&T In-House Limits for Feb 14, 2005 - Aug 13, 2005

C&T internal list numbers: 56331, 56332

EPA 8260B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	1,1-Dichloroethene	75 - 121	20	70 - 124	20
	Benzene	80 - 120	20	79 - 120	20
	Trichloroethene	78 - 120	20	71 - 120	20
	Toluene	80 - 120	20	77 - 120	20
	Chlorobenzene	80 - 120	20	80 - 120	20
	Freon 12	45 - 120	20	43 - 120	20
	Chloromethane	55 - 120	21	57 - 120	20
	Vinyl Chloride	57 - 120	21	58 - 120	20
	Bromomethane	52 - 151	28	51 - 137	29
	Chloroethane	64 - 121	20	68 - 122	20
	Trichlorofluoromethane	73 - 133	20	69 - 129	20
	Acetone	53 - 143	28	56 - 132	21
	Freon 113	73 - 139	20	65 - 135	20
	Methylene Chloride	74 - 120	20	78 - 125	20
	MTBE	72 - 129	20	75 - 122	20
	Carbon Disulfide	69 - 120	20	65 - 120	20
	trans-1,2-Dichloroethene	75 - 120	20	74 - 122	20
	Vinyl Acetate	54 - 132	20	54 - 121	20
	1,1-Dichloroethane	73 - 120	20	76 - 121	20
	2-Butanone	64 - 128	20	65 - 131	20
	cis-1,2-Dichloroethene	76 - 121	20	76 - 124	20
	2,2-Dichloropropane	70 - 142	20	65 - 126	22
	Chloroform	74 - 120	20	77 - 120	20
	Bromochloromethane	76 - 120	20	77 - 121	20
	1,1,1-Trichloroethane	76 - 124	20	75 - 121	20
	1,1-Dichloropropene	76 - 121	20	72 - 120	20
	Carbon Tetrachloride	76 - 130	20	70 - 131	20
	1,2-Dichloroethane	75 - 120	20	78 - 120	20
	1,2-Dichloropropane	75 - 120	20	75 - 120	20
	Bromodichloromethane	80 - 127	20	80 - 123	20
	Dibromomethane	80 - 120	20	79 - 120	20
	4-Methyl-2-Pentanone	66 - 121	20	68 - 127	20
	cis-1,3-Dichloropropene	80 - 122	20	74 - 120	20
	trans-1,3-Dichloropropene	76 - 120	20	71 - 120	20
	1,1,2-Trichloroethane	80 - 120	20	77 - 120	20
	2-Hexanone	66 - 129	20	66 - 132	20
	1,3-Dichloropropane	80 - 120	20	77 - 120	20
	Tetrachloroethene	80 - 125	20	71 - 120	20
	Dibromochloromethane	80 - 120	20	80 - 120	20
	1,2-Dibromoethane	80 - 120	20	77 - 120	20
	1,1,1,2-Tetrachloroethane	80 - 120	20	80 - 120	20
	Ethylbenzene	80 - 120	20	73 - 120	20
	m,p-Xylenes	80 - 120	20	70 - 120	20
	o-Xylene	80 - 120	20	68 - 120	20
	Styrene	80 - 122	20	66 - 120	20
	Bromoform	77 - 124	20	74 - 121	20
	Isopropylbenzene	74 - 120	20	64 - 120	20
	1,1,2,2-Tetrachloroethane	75 - 120	20	76 - 121	20

EPA 8260B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
	1,2,3-Trichloropropane	73 - 120	20	74 - 126	20
	Propylbenzene	80 - 121	20	69 - 120	20
	Bromobenzene	80 - 120	20	80 - 120	20
	1,3,5-Trimethylbenzene	79 - 122	20	68 - 120	20
	2-Chlorotoluene	79 - 120	20	72 - 120	20
	4-Chlorotoluene	79 - 120	20	71 - 120	20
	tert-Butylbenzene	80 - 120	20	68 - 120	20
	1,2,4-Trimethylbenzene	78 - 123	20	67 - 120	20
	sec-Butylbenzene	80 - 122	20	68 - 120	20
	para-Isopropyl Toluene	75 - 121	20	63 - 120	20
	1,3-Dichlorobenzene	80 - 120	20	78 - 120	20
	1,4-Dichlorobenzene	80 - 120	20	80 - 120	20
	n-Butylbenzene	72 - 133	20	60 - 125	20
	1,2-Dichlorobenzene	80 - 120	20	79 - 120	20
	1,2-Dibromo-3-Chloropropane	68 - 127	20	65 - 137	20
	1,2,4-Trichlorobenzene	69 - 132	20	61 - 126	20
	Hexachlorobutadiene	74 - 136	20	65 - 125	20
	Naphthalene	59 - 148	20	58 - 138	27
	1,2,3-Trichlorobenzene	70 - 133	20	65 - 126	20
	tert-Butyl Alcohol (TBA)	65 - 139	27	67 - 147	25
	Isopropyl Ether (DIPE)	76 - 120	20	79 - 120	20
	Ethyl tert-Butyl Ether (ETBE)	80 - 120	20	80 - 120	20
	Methyl tert-Amyl Ether (TAME)	80 - 120	20	80 - 120	20
	Gasoline C6-C10	70 - 130	20	60 - 140	30
	Gasoline C7-C12	70 - 130	20	60 - 140	30
	Dibromofluoromethane	80 - 120		80 - 120	
	1,2-Dichloroethane-d4	80 - 122		80 - 122	
	Toluene-d8	80 - 120		80 - 120	
	Bromofluorobenzene	80 - 124		80 - 124	
	Trifluorotoluene	74 - 125		74 - 125	
Soil	1,1-Dichloroethene	77 - 124	20	70 - 120	20
	Benzene	80 - 120	20	70 - 120	20
	Trichloroethene	80 - 120	20	65 - 126	20
	Toluene	80 - 120	20	64 - 120	20
	Chlorobenzene	80 - 120	20	59 - 120	20
	Freon 12	33 - 126	33	37 - 120	23
	Chloromethane	49 - 120	31	46 - 120	22
	Vinyl Chloride	45 - 127	29	31 - 120	29
	Bromomethane	54 - 142	40	46 - 123	22
	Chloroethane	55 - 130	36	48 - 120	21
	Trichlorofluoromethane	64 - 147	23	62 - 129	21
	Acetone	59 - 167	31	45 - 168	23
	Freon 113	80 - 135	20	78 - 130	20
	Methylene Chloride	71 - 120	20	42 - 127	20
	MTBE	76 - 128	20	69 - 122	20
	Carbon Disulfide	68 - 128	20	59 - 120	20

EPA 8260B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
	trans-1,2-Dichloroethene	74 - 123	21	69 - 120	20
	Vinyl Acetate	47 - 133	29	1 - 120	66
	1,1-Dichloroethane	68 - 124	20	67 - 120	20
	2-Butanone	59 - 141	26	51 - 135	22
	cis-1,2-Dichloroethene	75 - 122	20	69 - 120	20
	2,2-Dichloropropane	74 - 132	23	69 - 120	20
	Chloroform	72 - 120	20	68 - 120	20
	Bromochloromethane	76 - 120	20	70 - 120	20
	1,1,1-Trichloroethane	73 - 130	22	69 - 120	20
	1,1-Dichloropropene	78 - 124	20	69 - 120	20
	Carbon Tetrachloride	80 - 129	20	73 - 120	20
	1,2-Dichloroethane	75 - 120	20	64 - 120	20
	1,2-Dichloropropane	73 - 120	20	65 - 120	20
	Bromodichloromethane	80 - 126	20	67 - 120	20
	Dibromomethane	79 - 120	20	67 - 120	20
	4-Methyl-2-Pentanone	63 - 129	20	55 - 122	22
	cis-1,3-Dichloropropene	80 - 121	20	61 - 120	20
	trans-1,3-Dichloropropene	78 - 120	20	56 - 120	20
	1,1,2-Trichloroethane	80 - 120	20	61 - 120	20
	2-Hexanone	62 - 133	20	48 - 125	25
	1,3-Dichloropropane	72 - 120	20	62 - 120	20
	Tetrachloroethene	80 - 128	20	63 - 122	20
	Dibromochloromethane	74 - 122	20	60 - 120	20
	1,2-Dibromoethane	80 - 120	20	64 - 120	20
	1,1,1,2-Tetrachloroethane	78 - 120	20	63 - 120	20
	Ethylbenzene	80 - 120	20	61 - 120	20
	m,p-Xylenes	80 - 120	20	59 - 120	20
	o-Xylene	79 - 120	20	58 - 120	20
	Styrene	80 - 121	20	54 - 120	20
	Bromoform	76 - 126	21	57 - 120	20
	Isopropylbenzene	70 - 120	20	51 - 120	20
	1,1,2,2-Tetrachloroethane	64 - 120	21	44 - 120	22
	1,2,3-Trichloropropane	67 - 120	20	55 - 120	21
	Propylbenzene	76 - 122	20	53 - 120	20
	Bromobenzene	78 - 120	20	55 - 120	20
	1,3,5-Trimethylbenzene	77 - 120	20	52 - 120	22
	2-Chlorotoluene	76 - 120	20	52 - 120	20
	4-Chlorotoluene	76 - 120	20	50 - 120	20
	tert-Butylbenzene	78 - 122	20	54 - 120	23
	1,2,4-Trimethylbenzene	76 - 121	20	48 - 120	24
	sec-Butylbenzene	78 - 123	20	50 - 120	24
	para-Isopropyl Toluene	77 - 121	20	47 - 120	25
	1,3-Dichlorobenzene	80 - 120	20	48 - 120	21
	1,4-Dichlorobenzene	80 - 120	20	48 - 120	21
	n-Butylbenzene	75 - 130	20	40 - 121	30
	1,2-Dichlorobenzene	80 - 120	20	47 - 120	21
	1,2-Dibromo-3-Chloropropane	62 - 126	20	43 - 120	27
	1,2,4-Trichlorobenzene	75 - 135	25	27 - 120	35

EPA 8260B QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	RPD	MS/MSD Recovery	RPD
	Hexachlorobutadiene	79 - 134	20	34 - 124	36
	Naphthalene	64 - 134	31	26 - 122	37
	1,2,3-Trichlorobenzene	73 - 131	26	26 - 120	35
	tert-Butyl Alcohol (TBA)	65 - 136	23	51 - 131	33
	Isopropyl Ether (DIPE)	75 - 122	20	72 - 120	21
	Ethyl tert-Butyl Ether (ETBE)	75 - 120	20	74 - 120	20
	Methyl tert-Amyl Ether (TAME)	75 - 120	20	76 - 120	20
	Dibromofluoromethane	78 - 120		78 - 120	
	1,2-Dichloroethane-d4	80 - 120		80 - 120	
	Toluene-d8	80 - 120		80 - 120	
	Bromofluorobenzene	80 - 120		80 - 120	
	Trifluorotoluene	52 - 135		52 - 135	

C&T internal list numbers: 56352, 56354

Curtis & Tompkins, Ltd.

EPA 8270C QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
Water	Phenol	43 - 120	25	44 - 120	28
	2-Chlorophenol	51 - 120	24	51 - 120	24
	1,4-Dichlorobenzene	36 - 120	35	39 - 120	29
	N-Nitroso-di-n-propylamine	45 - 120	27	44 - 120	25
	1,2,4-Trichlorobenzene	38 - 120	30	41 - 120	24
	4-Chloro-3-methylphenol	48 - 120	25	50 - 120	23
	Acenaphthene	43 - 120	24	47 - 120	23
	4-Nitrophenol	43 - 120	23	38 - 120	27
	2,4-Dinitrotoluene	46 - 120	24	33 - 120	22
	Pentachlorophenol	35 - 120	28	25 - 148	25
	Pyrene	38 - 120	24	46 - 120	23
	N-Nitrosodimethylamine	42 - 120	25	40 - 120	30
	Dimethyl formamide	50 - 150	40	50 - 150	40
	bis(2-Chloroethyl)ether	42 - 120	26	46 - 120	24
	1,3-Dichlorobenzene	34 - 120	39	37 - 120	29
	Benzyl alcohol	48 - 120	25	43 - 120	30
	1,2-Dichlorobenzene	38 - 120	35	40 - 120	28
	2-Methylphenol	50 - 120	25	53 - 120	24
	bis(2-Chloroisopropyl) ether	45 - 120	24	43 - 120	24
	4-Methylphenol	47 - 120	24	47 - 120	28
	Hexachloroethane	29 - 120	42	29 - 120	31
	Nitrobenzene	51 - 120	24	53 - 120	25
	Isophorone	43 - 120	23	45 - 120	21
	2-Nitrophenol	49 - 120	25	49 - 120	21
	2,4-Dimethylphenol	43 - 120	28	45 - 120	27
	Benzoic acid	19 - 120	54	29 - 120	42
	bis(2-Chloroethoxy)methane	46 - 120	23	49 - 120	22
	2,4-Dichlorophenol	48 - 120	24	50 - 120	21
	Naphthalene	45 - 120	26	46 - 120	24
	4-Chloroaniline	17 - 120	55	12 - 120	54
	Hexachlorobutadiene	31 - 120	35	33 - 120	29
	2-Methylnaphthalene	48 - 120	24	49 - 120	23
	Hexachlorocyclopentadiene	4 - 120	45	1 - 120	42
	2,4,6-Trichlorophenol	47 - 120	25	48 - 120	24
	2,4,5-Trichlorophenol	48 - 120	25	48 - 120	24
	2-Chloronaphthalene	44 - 120	25	48 - 120	23
	2-Nitroaniline	45 - 120	24	31 - 120	35
	Dimethylphthalate	47 - 120	25	49 - 120	24
	Acenaphthylene	40 - 120	24	44 - 120	23
	2,6-Dinitrotoluene	45 - 120	25	45 - 120	24
	3-Nitroaniline	32 - 120	32	16 - 120	39
	2,4-Dinitrophenol	34 - 120	31	50 - 120	27
	Dibenzofuran	49 - 120	25	46 - 120	25

SPIKES

Curtis & Tompkins, Ltd.

EPA 8270C QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
	Diethylphthalate	45 - 120	23	47 - 120	24
	Fluorene	42 - 120	23	48 - 120	23
	4-Chlorophenyl-phenylether	42 - 120	24	47 - 120	24
	4-Nitroaniline	37 - 120	29	20 - 120	25
	4,6-Dinitro-2-methylphenol	42 - 120	27	43 - 120	27
	N-Nitrosodiphenylamine	36 - 120	23	40 - 120	28
	Azobenzene	38 - 120	25	42 - 120	26
	4-Bromophenyl-phenylether	40 - 120	25	46 - 120	24
	Hexachlorobenzene	40 - 120	23	46 - 120	24
	Phenanthrene	41 - 120	23	47 - 120	23
	Anthracene	38 - 120	24	45 - 120	22
	Di-n-butylphthalate	38 - 120	24	37 - 122	24
	Fluoranthene	38 - 120	24	46 - 120	22
	Butylbenzylphthalate	36 - 120	24	36 - 120	24
	3,3'-Dichlorobenzidine	23 - 120	26	1 - 129	56
	Benzo(a)anthracene	39 - 120	24	47 - 120	24
	Chrysene	41 - 120	23	46 - 120	22
	bis(2-Ethylhexyl)phthalate	36 - 121	27	30 - 125	29
	Di-n-octylphthalate	34 - 120	23	33 - 124	26
	Benzo(b)fluoranthene	36 - 120	25	34 - 120	24
	Benzo(k)fluoranthene	41 - 120	27	33 - 120	28
	Benzo(a)pyrene	42 - 120	24	44 - 120	22
	Indeno(1,2,3-cd)pyrene	38 - 120	25	39 - 120	22
	Dibenz(a,h)anthracene	38 - 120	25	39 - 120	23
	Benzo(g,h,i)perylene	33 - 120	25	30 - 120	22
	2-Fluorophenol	41 - 120		41 - 120	
	Phenol-d5	41 - 120		41 - 120	
	2,4,6-Tribromophenol	38 - 120		38 - 120	
	Nitrobenzene-d5	47 - 120		47 - 120	
	2-Fluorobiphenyl	44 - 120		44 - 120	
	Terphenyl-d14	16 - 120		16 - 120	
Soil	Phenol	33 - 120	20	32 - 120	33
	2-Chlorophenol	39 - 120	20	40 - 120	33
	1,4-Dichlorobenzene	40 - 120	20	40 - 120	32
	N-Nitroso-di-n-propylamine	38 - 120	20	41 - 120	33
	1,2,4-Trichlorobenzene	37 - 120	20	38 - 120	32
	4-Chloro-3-methylphenol	41 - 120	20	40 - 120	32
	Acenaphthene	34 - 120	20	36 - 120	32
	4-Nitrophenol	31 - 120	20	28 - 120	35
	2,4-Dinitrotoluene	37 - 120	20	36 - 120	35
	Pentachlorophenol	25 - 120	20	4 - 120	51

Spikes

Surrogates

Curtis & Tompkins, Ltd.

EPA 8270C QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
	Pyrene	37 - 120	20	35 - 130	36
	Dimethyl formamide	60 - 140	20	50 - 150	30
	bis(2-Chloroethyl)ether	36 - 120	20	35 - 120	31
	1,3-Dichlorobenzene	38 - 120	20	39 - 120	33
	Benzyl alcohol	40 - 120	20	36 - 120	34
	1,2-Dichlorobenzene	40 - 120	20	45 - 120	32
	2-Methylphenol	40 - 120	20	38 - 120	32
	bis(2-Chloroisopropyl) ether	35 - 120	20	37 - 120	31
	4-Methylphenol	39 - 120	20	37 - 120	31
	Hexachloroethane	39 - 120	20	28 - 120	41
	Nitrobenzene	38 - 120	20	44 - 120	31
	Isophorone	37 - 120	20	36 - 120	33
	2-Nitrophenol	39 - 120	20	34 - 120	34
	2,4-Dimethylphenol	39 - 120	20	37 - 120	33
	Benzoic acid	4 - 120	20	1 - 120	48
	bis(2-Chloroethoxy)methane	41 - 120	20	36 - 120	30
	2,4-Dichlorophenol	37 - 120	20	37 - 120	31
	Naphthalene	38 - 120	20	42 - 120	32
	4-Chloroaniline	15 - 120	20	3 - 120	53
	Hexachlorobutadiene	36 - 120	20	43 - 120	31
	2-Methylnaphthalene	38 - 120	20	38 - 120	33
	Hexachlorocyclopentadiene	15 - 120	20	1 - 120	66
	2,4,6-Trichlorophenol	39 - 120	20	36 - 120	34
	2,4,5-Trichlorophenol	41 - 120	20	38 - 120	34
	2-Chloronaphthalene	37 - 120	20	39 - 120	31
	2-Nitroaniline	36 - 120	20	33 - 120	33
	Dimethylphthalate	40 - 120	20	32 - 121	32
	Acenaphthylene	36 - 120	20	37 - 120	31
	2,6-Dinitrotoluene	39 - 120	20	37 - 120	33
	3-Nitroaniline	15 - 120	20	8 - 120	41
	2,4-Dinitrophenol	1 - 120	20	1 - 120	58
	Dibenzofuran	37 - 120	20	37 - 120	34
	Diethylphthalate	39 - 120	20	38 - 120	31
	Fluorene	36 - 120	20	36 - 120	32
	4-Chlorophenyl-phenylether	37 - 120	20	39 - 120	31
	4-Nitroaniline	33 - 120	20	22 - 120	40
	4,6-Dinitro-2-methylphenol	7 - 120	20	1 - 120	58
	N-Nitrosodiphenylamine	36 - 120	20	30 - 124	32
	Azobenzene	35 - 120	20	34 - 123	33
	4-Bromophenyl-phenylether	35 - 120	20	32 - 129	33
	Hexachlorobenzene	36 - 120	20	30 - 124	33
	Phenanthrene	36 - 120	20	32 - 123	36
	Anthracene	35 - 120	20	34 - 120	31

Curtis & Tompkins, Ltd.

EPA 8270C QC Limits

C&T In-House Limits for
Feb 14, 2005 - Aug 13, 2005

Matrix	Analyte	LCS/LCSD Recovery	LCS/LCSD RPD	MS/MSD Recovery	MS/MSD RPD
	Di-n-butylphthalate	38 - 120	20	36 - 122	30
	Fluoranthene	36 - 120	20	31 - 120	34
	Butylbenzylphthalate	37 - 120	20	36 - 133	33
	3,3'-Dichlorobenzidine	9 - 120	20	1 - 120	50
	Benzo(a)anthracene	37 - 120	20	40 - 120	32
	Chrysene	36 - 120	20	39 - 120	35
	bis(2-Ethylhexyl)phthalate	34 - 123	20	26 - 149	33
	Di-n-octylphthalate	31 - 120	20	21 - 171	33
	Benzo(b)fluoranthene	31 - 120	20	32 - 120	34
	Benzo(k)fluoranthene	34 - 120	20	33 - 127	34
	Benzo(a)pyrene	39 - 120	20	39 - 120	33
	Indeno(1,2,3-cd)pyrene	28 - 121	20	15 - 120	41
	Dibenz(a,h)anthracene	29 - 125	20	22 - 120	38
	Benzo(g,h,i)perylene	21 - 122	20	7 - 120	43
Surrogates	2-Fluorophenol	29 - 120		29 - 120	
	Phenol-d5	26 - 120		26 - 120	
	2,4,6-Tribromophenol	27 - 120		27 - 120	
	Nitrobenzene-d5	38 - 120		38 - 120	
	2-Fluorobiphenyl	41 - 120		41 - 120	
	Terphenyl-d14	32 - 120		32 - 120	

C&T internal list numbers: 56356, 56358

VOLATILE ORGANIC COMPOUNDS

Purgeable Hydrocarbons (TPH-G)
EPA 8015B

CAS #	Compound	Reporting Limit µg/L	Reporting Limit mg/Kg
8006-61-9	Gasoline	50	1
Additional Compounds (may be added to target list):			
	JP-4 Jet Fuel	50	1
	Mineral Spirits	50	1
	Stoddard Solvent	50	1
Surrogates:			
98-08-8	Trifluorotoluene		
460-00-4	Bromofluorobenzene		

BTXE
EPA 8021B

CAS #	Compound	Reporting Limit µg/L	Reporting Limit µg/Kg
71-43-2	Benzene	0.5	5
100-41-4	Ethylbenzene	0.5	5
108-88-3	Toluene	0.5	5
1330-20-7	m,p-Xylenes	0.5	5
95-47-6	o-Xylene	0.5	5
Additional Compounds (may be added to target list):			
1634-04-4	MTBE	0.5	5
Surrogates:			
98-08-8	Trifluorotoluene		
460-00-4	Bromofluorobenzene		

Gasoline Oxygenates
EPA 8260B

CAS #	Compound	Water RL µg/L	Soil RL µg/Kg
75-65-0	tert-Butyl Alcohol (TBA)	10	100
106-93-4	1,2-Dibromoethane (EDB)	0.5	5
107-06-2	1,2-Dichloroethane (DCA or EDC)	0.5	5
637-92-3	Ethyl tert-Butyl Ether (ETBE)	0.5	5
108-20-3	Isopropyl Ether (DIPE)	0.5	5
994-05-8	Methyl tert-Amyl Ether (TAME)	0.5	5
1634-04-4	Methyl tert-Butyl Ether (MTBE)	0.5	5
Additional Compounds (may be added to the compound list):			
64-17-5	Ethanol	2,000	2,000
Surrogates:			
460-00-4	Bromofluorobenzene		
1868-53-7	Dibromofluoromethane		
17060-07-0	1,2-Dichloroethane-d4		
2037-26-5	Toluene-d8		

Volatile Organic Compounds
EPA 8260B

CAS #	Compound	Water RL µg/L	Low Level Water µg/L	Soil RL µg/Kg
67-64-1	Acetone	20	10	20
71-43-2	Benzene	5	0.5	5
108-86-1	Bromobenzene	5	0.5	5
74-97-5	Bromochloromethane	10	0.5	10
75-27-4	Bromodichloromethane	5	0.5	5
75-25-2	Bromoform	5	1	5
74-83-9	Bromomethane	10	1	10
78-93-3	2-Butanone	10	10	10
104-51-8	n-Butylbenzene	5	0.5	5
135-98-8	sec-Butylbenzene	5	0.5	5
98-06-6	tert-Butylbenzene	5	0.5	5
75-15-0	Carbon disulfide	5	0.5	5
56-23-5	Carbon tetrachloride	5	0.5	5
108-90-7	Chlorobenzene	5	0.5	5
75-00-3	Chloroethane	10	1	10
67-66-3	Chloroform	5	0.5	5
74-87-3	Chloromethane	10	1	10
95-49-8	2-Chlorotoluene	5	0.5	5
106-43-4	4-Chlorotoluene	5	0.5	5
124-48-1	Dibromochloromethane	5	0.5	5
96-12-8	1,2-Dibromo-3-chloropropane	5	0.5	5
106-93-4	1,2-Dibromoethane (EDB)	5	0.5	5
74-95-3	Dibromomethane	5	0.5	5
95-50-1	1,2-Dichlorobenzene	5	0.5	5
541-73-1	1,3-Dichlorobenzene	5	0.5	5
106-46-7	1,4-Dichlorobenzene	5	0.5	5
75-34-3	1,1-Dichloroethane	5	0.5	5
107-06-2	1,2-Dichloroethane	5	0.5	5
75-35-4	1,1-Dichloroethene	5	0.5	5
156-59-2	cis-1,2-Dichloroethene	5	0.5	5
156-60-5	trans-1,2-Dichloroethene	5	0.5	5
78-87-5	1,2-Dichloropropane	5	0.5	5
142-28-9	1,3-Dichloropropane	5	0.5	5
594-20-7	2,2-Dichloropropane	5	0.5	5
563-58-6	1,1-Dichloropropene	5	0.5	5
10061-01-5	cis-1,3-Dichloropropene	5	0.5	5
10061-02-6	trans-1,3-Dichloropropene	5	0.5	5
100-41-4	Ethylbenzene	10	1	10
75-71-8	Freon 12	5	5	5
76-13-1	Freon 113	5	0.5	5
87-68-3	Hexachlorobutadiene	10	10	10
591-78-6	2-Hexanone	5	0.5	5
98-82-8	Isopropylbenzene	5	0.5	5
99-87-6	para-Isopropyl toluene	20	10	20
75-09-2	Methylene chloride	10	0.5	10
108-10-1	4-Methyl-2-pentanone	5	0.5	5
1634-04-4	Methyl t-butyl ether (MTBE)	5	0.5	5
91-20-3	Naphthalene	5	0.5	5
103-65-1	Propylbenzene	5	0.5	5
100-42-5	Styrene	5	0.5	5
630-20-6	1,1,1,2-Tetrachloroethane	5	0.5	5
79-34-5	1,1,2,2-Tetrachloroethane	5	0.5	5
127-18-4	Tetrachloroethene	5	0.5	5
108-88-3	Toluene	5	0.5	5
87-61-6	1,2,3-Trichlorobenzene	5	0.5	5
120-82-1	1,2,4-Trichlorobenzene	5	0.5	5
71-55-6	1,1,1-Trichloroethane	5	0.5	5

Alcohols
EPA 8015B

CAS #	Compound	Water RL mg/L
64-17-5	Ethanol	1
87-56-1	Methanol	1
Surrogate:		
74-41-0	1-Pentanol	

Dissoved Gasses
RSK-175

CAS #	Compound	Water RL mg/L
74-82-8	Methane	0.005
72-84-0	Ethane	0.005
74-85-1	Ethene	0.005
Additional Compounds (may be added to the compound list):		
74-86-2	Acetylene	0.005
124-38-9	Carbon Dioxide	1

Extractable Hydrocarbons (TPH-D)
EPA 8015B

CAS #	Compound	Water RL µg/L	Soil RL mg/Kg
68334-30-5	Diesel	50	1
Additional Compounds (may be added to the compound list):			
	Bunker C	50	1
	Commercial Jet Fuel	50	1
	JP-5 Jet Fuel	50	1
	Kerosene	50	1
	Hydraulic Fluid	300	5
	Motor Oil	300	5
	Transformer Oil	300	5
Surrogate:			
630-01-3	Hexacosane		

PCB Congeners
EPA 8082

BZ #	Compound	Water RL µg/L	Soil RL µg/Kg
8	2,4'-Dichlorobiphenyl	0.05	0.5
18	2,2',5-Trichlorobiphenyl	0.05	0.5
28	2,4,4'-Trichlorobiphenyl	0.05	0.5
44	2,2',3,5'-Tetrachlorobiphenyl	0.05	0.5
52	2,2',5,5'-Tetrachlorobiphenyl	0.05	0.5
66	2,3',4,4'-Tetrachlorobiphenyl	0.05	0.5
77	3,3',4,4'-Tetrachlorobiphenyl	0.05	0.5
81	3,4,4',5-Tetrachlorobiphenyl	0.05	0.5
101	2,2',4,5,5'-Pentachlorobiphenyl	0.05	0.5
105	2,3,3',4,4'-Pentachlorobiphenyl	0.05	0.5
114	2,3,4,4',5-Pentachlorobiphenyl	0.05	0.5
118	2,3',4,4',5-Pentachlorobiphenyl	0.05	0.5
123	2,3',4,4',5'-Pentachlorobiphenyl	0.05	0.5
126	3,3',4,4',5-Pentachlorobiphenyl	0.05	0.5
128	2,2',3,3',4,4'-Hexachlorobiphenyl	0.05	0.5
138	2,2',3,4,4',5'-Hexachlorobiphenyl	0.05	0.5
153	2,2',4,4',5,5'-Hexachlorobiphenyl	0.05	0.5
156	2,3,3',4,4',5-Hexachlorobiphenyl	0.05	0.5
157	2,3,3',4,4',5'-Hexachlorobiphenyl	0.05	0.5
167	2,3',4,4',5,5'-Hexachlorobiphenyl	0.05	0.5
169	3,3',4,4',5,5'-Hexachlorobiphenyl	0.05	0.5
170	2,2',3,3',4,4',5-Heptachlorobiphenyl	0.05	0.5
180	2,2',3,4,4',5,5'-Heptachlorobiphenyl	0.05	0.5
187	2,2',3,4',5,5',6-Heptachlorobiphenyl	0.05	0.5
189	2,3,3',4,4',5,5'-Heptachlorobiphenyl	0.05	0.5
195	2,2',3,3',4,4',5,6-Octachlorobiphenyl	0.05	0.5
206	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	0.05	0.5
Surrogate:			
205	2,3,3',4,4',5,5',6-Octachlorobiphenyl		

Semivolatile Organics
EPA 8270C

CAS #	Compound	Water RL µg/L	Soil RL µg/Kg
86-30-6	N-Nitrosodiphenylamine	10	330
91-20-3	Naphthalene	10	67
98-95-3	Nitrobenzene	10	330
87-86-5	Pentachlorophenol	20	670
85-01-8	Phenanthrene	10	67
108-95-2	Phenol	10	330
129-00-0	Pyrene	10	67
120-82-1	1,2,4-Trichlorobenzene	10	330
95-95-4	2,4,5-Trichlorophenol	10	1,700
88-06-2	2,4,6-Trichlorophenol	10	330
Surrogates:			
321-60-8	2-Fluorobiphenyl		
367-12-4	2-Fluorophenol		
4165-60-0	Nitrobenzene-d5		
13127-88-3	Phenol-d5		
1718-51-0	Terphenyl-d14		
118-79-6	2,4,6-Tribromophenol		

Polynuclear Aromatic Hydrocarbons (PAH)
EPA 8270-SIM

CAS #	Compound	Water RL µg/L	Soil RL µg/Kg
83-32-9	Acenaphthene	0.1	5
208-96-8	Acenaphthylene	0.1	5
120-12-7	Anthracene	0.1	5
56-55-3	Benzo(a)anthracene	0.1	5
50-32-8	Benzo(a)pyrene	0.1	5
205-99-2	Benzo(b)fluoranthene	0.1	5
207-08-9	Benzo(k)fluoranthene	0.1	5
191-24-2	Benzo(g,h,i)perylene	0.1	5
218-01-9	Chrysene	0.1	5
53-70-3	Dibenz(a,h)anthracene	0.1	5
206-44-0	Fluoranthene	0.1	5
86-73-7	Fluorene	0.1	5
193-39-5	Indeno(1,2,3-cd)pyrene	0.1	5
91-20-3	Naphthalene	0.1	5
85-01-8	Phenanthrene	0.1	5
129-00-0	Pyrene	0.1	5
Surrogates:			
321-60-8	2-Fluorobiphenyl		
4165-60-0	Nitrobenzene-d5		
1718-51-0	Terphenyl-d14		

1,4-Dioxane
EPA 8270-SIM

CAS #	Compound	Water RL µg/L
123-91-1	1,4-Dioxane	1
Surrogates:		
321-60-8	2-Fluorobiphenyl	
4165-60-0	Nitrobenzene-d5	

METALS

CA Title-22 Metals
EPA 6010B/7400

CAS #		Element	Reporting Limit µg/L	Reporting Limit mg/Kg
7440-36-0	Sb	Antimony	60	3
7440-38-2	As	Arsenic	5	0.25
7440-39-3	Ba	Barium	10	0.5
7440-41-7	Be	Beryllium	2	0.1
7440-43-9	Cd	Cadmium	5	0.25
7440-47-3	Cr	Chromium	10	0.5
7440-48-4	Co	Cobalt	20	1
7440-50-8	Cu	Copper	10	0.5
7439-92-1	Pb	Lead	3	0.15
7439-97-6	Hg	Mercury	0.2	0.02
7439-98-7	Mo	Molybdenum	20	1
7440-02-0	Ni	Nickel	20	1
7782-49-2	Se	Selenium	5	0.25
7440-22-4	Ag	Silver	5	0.25
7440-28-0	Tl	Thallium	5	0.25
7440-62-2	V	Vanadium	10	0.5
7440-66-6	Zn	Zinc	20	1

Cations
EPA 6010B

CAS #		Element	Reporting Limit µg/L	Reporting Limit mg/Kg
7429-90-5	Al	Aluminum	100	10
7440-70-2	Ca	Calcium	500	25
7439-89-6	Fe	Iron	100	5
7439-95-4	Mg	Magnesium	500	25
7439-96-5	Mn	Manganese	10	0.5
7440-09-7	K	Potassium	500	25
7440-23-5	Na	Sodium	500	25

Miscellaneous Metals
EPA 6010B

CAS #		Element	Reporting Limit µg/L	Reporting Limit mg/Kg
7440-42-8	B	Boron	20	1
7723-14-0	P	Phosphorous	100	5
7440-21-3	Si	Silicon	200	10
7440-31-5	Sn	Tin	40	2
7440-32-6	Ti	Titanium	10	0.5

ICP-MS Metals
EPA 6020

CAS #		Element	Reporting Limit µg/L	Reporting Limit mg/Kg
7429-90-5	Al	Aluminum	50	10
7440-36-0	Sb	Antimony	0.25	0.25
7440-38-2	As	Arsenic	0.5	0.25
7440-39-3	Ba	Barium	0.25	0.25
7440-41-7	Be	Beryllium	0.25	0.25
7440-43-9	Cd	Cadmium	0.25	0.25
7440-70-2	Ca	Calcium	50	10
7440-47-3	Cr	Chromium	0.5	0.50
7440-48-4	Co	Cobalt	0.25	0.25
7440-50-8	Cu	Copper	0.5	0.25
7439-89-6	Fe	Iron	50	10
7439-92-1	Pb	Lead	0.25	0.25
7439-95-4	Mg	Magnesium	50	10
7439-96-5	Mn	Manganese	0.25	0.25
7439-98-7	Mo	Molybdenum	0.5	1.3
7440-02-0	Ni	Nickel	0.25	0.5
7440-09-7	K	Potassium	50	25
7782-49-2	Se	Selenium	0.5	0.25
7440-22-4	Ag	Silver	0.25	0.25
7440-23-5	Na	Sodium	50	25
7440-28-0	Tl	Thallium	0.5	0.25
7440-62-2	V	Vanadium	1	0.25
7440-66-6	Zn	Zinc	1	1.0

Mercury
EPA 7470A / EPA 7471A

CAS #		Element	Reporting Limit µg/L	Reporting Limit mg/Kg
7439-97-6	Hg	Mercury	0.2	0.02

GENERAL CHEMISTRY

Parameter	Method	Water RL	Soil RL
Acidity	EPA 305.1	1.0 mg/L	--
Alkalinity (as $CaCO_3$)	EPA 310.1	1.0 mg/L	2 mg/Kg
Ammonia Nitrogen	EPA 350.3	0.1 mg/L	10 mg/Kg
Bicarbonate Alkalinity	EPA 310.1	1.0 mg/L	2 mg/Kg
Bioassay, %survival	NPDES	Pass / Fail	--
Biochemical Oxygen Demand (BOD)	EPA 405.1	5.0 mg/L	--
BOD (Biochemical Oxygen Demand)	EPA 405.1	5.0 mg/L	--
Carbon, Total Organic	EPA 415.2	1.0 mg/L	50 mg/Kg
Carbon, Total Inorganic	EPA 415.2	1.0 mg/L	--
Carbonate Alkalinity	EPA 310.1	1.0 mg/L	2 mg/Kg
Cation Exchange Capacity	EPA 9081	--	5 meq/100g
Chemical Oxygen Demand (COD)	EPA 410.4 or SM5220D	10 mg/L	--
Chloride	EPA 300.0	0.2 mg/L	2 mg/Kg
Chlorine, Residual	EPA 330.5	0.2 mg/L	--
COD (Chemical Oxygen Demand)	EPA 410.4	10 mg/L	--
Coliform, Fecal		present	--
Color	AOCS methods	APHA scale	--
Conductivity	EPA 120.1	1 umhos/cm@25C	--
Corrosivity to Steel (NACE)	EPA 1110	6.35mm/yr	6.35 mm/yr
Chromium, Hexavalent	EPA 7196A	0.01 mg/L	0.05 mg/Kg
	EPA 7199	0.25 µg/L	--
Cyanide	EPA 335.2	0.01 mg/L	1 mg/Kg
	EPA 9010B / 9014	0.01 mg/L	1 mg/Kg
Cyanide, Amenable	EPA 9010	0.01 mg/L	1 mg/Kg
Cyanide, Reactive	SW846 Ch.7	10 mg/Kg	10 mg/Kg
Density	ASTM or AOCS	Varies	--
Dissolved Oxygen	EPA 360.1	1.0 mg/L	--
Ferrous Iron	SM 3500FeD	0.2 mg/L	--
Ferric Iron	SM 3500FeD	0.2 mg/L	--
Flash Point	EPA 1010	ambient deg.F	--
Fluoride	EPA 300.0	0.1 mg/L	1.0 mg/Kg
Free Liquids (Paint Filter Test)	EPA 9095	yes/no	yes/no
Halogens, Total Organic	EPA 9020	50 µg/L	10 mg/Kg
Hardness, as $CaCO_3$	EPA 130.2	3.3 mg/L	--
Hexavalent Chromium	EPA 7196A	0.01 mg/L	0.05 mg/Kg
Hexavalent Chromium	EPA 7199	0.5 µg/L	--
Ignitability	SW846 Ch.7	--	Yes / No
Iron, Ferrous (Fe^{2+})	SM 3500FeD	0.2 mg/L	--
Iron, Ferric (Fe^{3+})	SM 3500FeD	0.2 mg/L	--
MBAS (Surfactants)	EPA 425.1	0.1 mg/L	--
Moisture	CLP-SOW	--	%
Nitrate Nitrogen	EPA 300.0	0.05 mg/L	0.5 mg/Kg
Nitrite Nitrogen	EPA 300.0	0.05 mg/L	0.5 mg/Kg
Nitrate/Nitrite Nitrogen	EPA 300.0	0.1 mg/L	1 mg/Kg
Nitrogen, Ammonia	EPA 350.3	0.1 mg/L	10 mg/Kg
Nitrogen, Total Kjeldahl (TKN)	EPA 351.4	1.0 mg/L	100 mg/Kg
Oil & Grease, Petroleum (HEM-SG)	EPA 1664A	5.0 mg/L	--
Oil & Grease, Total (HEM.)	EPA 1664A	5.0 mg/L	--
Organic Lead	CA LUFT	100 µg/L	0.5 mg/Kg
Oxygen Demand, Biochemical	EPA 405.1	5.0 mg/L	--
Oxygen Demand, Chemical	EPA 410.4	10 mg/L	--
Oxygen, Dissolved	EPA 360.1	1.0 mg/L	--
Paint Filter Test	EPA 9095	yes/no	yes/no
Perchlorate	EPA 314.0	4.0 µg/L	--
pH	EPA 9040B / 9045C	0.1 SU	0.1 SU
Phenolic Compounds	EPA 420.1	0.05 mg/L	--
Phosphate, ortho-	EPA 300.0	0.2 mg/L	2 mg/Kg
Phosphate, Total	EPA 365.2	0.03 mg/L	0.3 mg/Kg

GENERAL CHEMISTRY

Major Anions	Method	Water RL	Soil RL
Bicarbonate	EPA 310.1	1.0 mg/L	2 mg/Kg
Carbonate	EPA 310.1	1.0 mg/L	2 mg/Kg
Chloride	EPA 300.0	0.2 mg/L	2 mg/Kg
Sulfate	EPA 300.0	0.5 mg/L	5 mg/Kg

Major Cations	Method	Water RL	Soil RL
Calcium	EPA 200.7 or 6010B	0.5 mg/L	25 mg/Kg
Magnesium	EPA 200.7 or 6010B	0.5 mg/L	25 mg/Kg
Potassium	EPA 200.7 or 6010B	0.5 mg/L	25 mg/Kg
Sodium	EPA 200.7 or 6010B	0.5 mg/L	25 mg/Kg

RCI Reactivity, Corrosivity & Ignitability	Method	Water RL	Soil RL
Reactive Cyanide	SW846 Ch.7	10 mg/Kg	10 mg/Kg
Reactive Sulfide	SW846 Ch.7	10 mg/Kg	10 mg/Kg
pH	EPA 9040B / 9045C	0.1 SU	0.1 SU
Ignitability	SW846 Ch.7	--	Yes / No

Ion Chromatography	Method	Water RL	Soil RL
Bromide	EPA 300.0	0.2 mg/L	2 mg/Kg
Chloride	EPA 300.0	0.2 mg/L	2 mg/Kg
Fluoride	EPA 300.0	0.1 mg/L	1 mg/Kg
Nitrate-Nitrogen	EPA 300.0	0.05 mg/L	0.5 mg/Kg
Nitrite Nitrogen	EPA 300.0	0.05 mg/L	0.5 mg/Kg
Ortho-Phosphate-Phosphorous	EPA 300.0	0.2 mg/L	2 mg/Kg
Sulfate	EPA 300.0	0.5 mg/L	5 mg/Kg
Hexavalent Chromium	EPA 7199	0.0005 mg/L	Not applicable
Perchlorate	EPA 314.0	0.004 mg/L	Not applicable

APPENDIX C-2

CORRECTIVE ACTION FORM

CORRECTIVE ACTION FORM

Date: _____

Job Name: _____

Initiator's Name and Title: _____

Problem Description: _____

_____

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Reported To: _____

Corrective Action: _____

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Reviewed and Implemented By: _____

cc: Project Manager: _____

Quality Assurance Officer: _____